Exhibit B

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
10/625,667	07/24/2003	John Lawrence Jordan	3437-Z

CONFIRMATION NO. 8923

POWER OF ATTORNEY NOTICE

Law Office of Jim Zegeer
Suite 108
801 North Pitt Street
Alexandria, VA 22314

OC000000032465159

Date Mailed: 10/08/2008

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 10/01/2008.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

/snguyen/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
10/625,667	07/24/2003	John Lawrence Jordan	ALC 3406

CONFIRMATION NO. 8923

POA ACCEPTANCE LETTER

76614
Kramer & Amado, P.C.
1725 Duke Street
Suite 240
Alexandria, VA 22314

OC00000032465179

Date Mailed: 10/08/2008

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 10/01/2008.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

/snguyen/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

Electronic Acknowledgement Receipt

EFS ID:	4040138
Application Number:	10625667
International Application Number:	
Confirmation Number:	8923
Title of Invention:	SOFTWARE CONFIGURABLE CLUSTER-BASED ROUTER USING STOCK PERSONAL COMPUTERS AS CLUSTER NODES
First Named Inventor/Applicant Name:	John Lawrence Jordan
Correspondence Address:	Law Office of Jim Zegeer - Suite 108 801 North Pitt Street Alexandria VA 22314 US 7036848333 -
Filer:	Terry Wayne Kramer/Wanda Ricks
Filer Authorized By:	Terry Wayne Kramer
Attorney Docket Number:	3437-Z
Receipt Date:	01-OCT-2008
Filing Date:	24-JUL-2003
Time Stamp:	12:00:09
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		ALC3406POA.pdf	470200 895a45cc0d45bc6f13e364197da9c8c5a0f135ee	yes	2

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Power of Attorney	1	1
Assignee showing of ownership per 37 CFR 3.73(b).	2	2

Warnings:	
Information:	
Total Files Size (in bytes):	470200

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Print Form

PTO/SB/81 (07-08)
Approved for use through 12/31/2008: OMB 0651-0035
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

POWER OF ATTORNEY OR REVOCATION OF POWER OF ATTORNEY WITH A NEW POWER OF ATTORNEY AND CHANGE OF CORRESPONDENCE ADDRESS

Application Number	10/625,667
Filing Date	July 24, 2003
First Named Inventor	JORDAN, John Lawrence
Title	SOFTWARE CONFIGURABLE CLUSTER-BASED ROUTER US...
Art Unit	2619
Examiner Name	MAIS, Mark
Attorney Docket Number	ALC 3406

I hereby revoke all previous powers of attorney given in the above-identified application.

☐ A Power of Attorney is submitted herewith.

OR

☒ I hereby appoint Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith: 76614

OR

☐ I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith:

Practitioner(s) Name	Registration Number

Please recognize or change the correspondence address for the above-identified application to:

☒ The address associated with the above-mentioned Customer Number.

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the:

☐ Applicant/Inventor.

OR

☒ Assignee of record of the entire interest. See 37 CFR 3.71.
Statement under 37 CFR 3.73(b) (Form PTO/SB/96) submitted herewith or filed on _____.

SIGNATURE of Applicant or Assignee of Record

Signature	Greg J. Murgia	Date	9/24/2008
Name	Gregory J. Murgia, Esq.	Telephone	+1 (908) 582-7109
Title and Company	Corporate Counsel, Authorized Representative of Alcatel		

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☒ *Total of 2 forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/SB/96 (01-08)
Approved for use through 06/30/2008. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner: ALCATEL LUCENT

Application No./Patent No.: 10/625,667 Filed/Issue Date: July 24, 2003

Entitled: SOFTWARE CONFIGURABLE CLUSTER-BASED ROUTER USING STOCK PERSONAL COMPUTERS AS CLUSTER NODES

ALCATEL LUCENT, a Corporation
(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that it is:

1. ☑ the assignee of the entire right, title, and interest; or

2. ☐ an assignee of less than the entire right, title and interest
(The extent (by percentage) of its ownership interest is _____ %)

in the patent application/patent identified above by virtue of either:

A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

OR

B. ☑ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: Inventors: JORDAN & RABINOVITCH To: ALCATEL
The document was recorded in the United States Patent and Trademark Office at
Reel 014333, Frame 0059, or for which a copy thereof is attached.

2. From: ALCATEL To: ALCATEL LUCENT
The document was recorded in the United States Patent and Trademark Office at
Reel 021496, Frame 0541, or for which a copy thereof is attached.

3. From: _____ To: _____
The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet.

☐ As required by 37 CFR 3.73(b)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (*i.e.*, a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

Signature — 9/24/2008 Date

Gregory J. Murgia — Printed or Typed Name

908 582-7109 — Telephone Number

Corporate Counsel, Authorized Representative of Alcatel — Title

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/625,667	10/14/2008	7436775	3437-Z	8923

7590 09/24/2008

Law Office of Jim Zegeer
Suite 108
801 North Pitt Street
Alexandria, VA 22314

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 897 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

John Lawrence Jordan, Ottawa, CANADA;
Peter Rabinovitch, Kanata, CANADA;

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any changes of address)

7590 06/01/2008

Law Office of Jim Zegeer
Suite 108
801 North Pitt Street
Alexandria, VA 22314

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of [illegible] Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

Michele M Rutter (Depositor's name)
Michele M Rutter (Signature)
9-9-08 (Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/625,667	07/24/2003	John Lawrence Jordan	3437-Z	8923

TITLE OF INVENTION: SOFTWARE CONFIGURABLE CLUSTER-BASED ROUTER USING STOCK PERSONAL COMPUTERS AS CLUSTER NODES

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1440	$300	$0	$1740	09/11/2008

EXAMINER	ART UNIT	CLASS-SUBCLASS
MAIS, MARK A	2619	370-388000

09/10/2008 MGEBREM2 00000009 122325 10625667
01 FC:1501 1440.00 DA
02 FC:1504 300.03 DA

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a Customer Number is required.

2. For printing on the patent front page, list:
(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Alcatel Lucent
(B) RESIDENCE: (CITY and STATE OR COUNTRY): Paris, France

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:
☒ Issue Fee
☒ Publication Fee (No small entity discount permitted)
☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): (Please first reapply any previously paid issue fee shown above)
☐ A check is enclosed.
☐ Payment by credit card. Form PTO-2038 is attached.
☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number 12-2325 (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)
☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.
☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature Michele M Rutter Date 9-9-08
Typed or printed name Michele M. Rutter Registration No. _____

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

7590 06/11/2008

Law Office of Jim Zegeer
Suite 108
801 North Pitt Street
Alexandria, VA 22314

EXAMINER	
MAIS, MARK A	
ART UNIT	PAPER NUMBER
2619	

DATE MAILED: 06/11/2008

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/625,667	07/24/2003	John Lawrence Jordan	3437-Z	8923

TITLE OF INVENTION: SOFTWARE CONFIGURABLE CLUSTER-BASED ROUTER USING STOCK PERSONAL COMPUTERS AS CLUSTER NODES

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1440	$300	$0	$1740	09/11/2008

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PTOL-85 (Rev. 08/07) Approved for use through 08/31/2010.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

7590 06/11/2008

Law Office of Jim Zegeer
Suite 108
801 North Pitt Street
Alexandria, VA 22314

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/625,667	07/24/2003	John Lawrence Jordan	3437-Z	8923

TITLE OF INVENTION: SOFTWARE CONFIGURABLE CLUSTER-BASED ROUTER USING STOCK PERSONAL COMPUTERS AS CLUSTER NODES

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1440	$300	$0	$1740	09/11/2008

EXAMINER	ART UNIT	CLASS-SUBCLASS
MAIS, MARK A	2619	370-388000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____

2 _____

3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:

❑ Issue Fee

❑ Publication Fee (No small entity discount permitted)

❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**

❑ A check is enclosed.

❑ Payment by credit card. Form PTO-2038 is attached.

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)

❑ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

❑ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/625,667	07/24/2003	John Lawrence Jordan	3437-Z	8923

7590 06/11/2008

Law Office of Jim Zegeer
Suite 108
801 North Pitt Street
Alexandria, VA 22314

EXAMINER	
MAIS, MARK A	
ART UNIT	PAPER NUMBER
2619	

DATE MAILED: 06/11/2008

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 897 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 897 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Notice of Allowability	Application No.	Applicant(s)	
	10/625,667	JORDAN ET AL.	
	Examiner	Art Unit	
	MARK A. MAIS	2619	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *the RCE filed on 29 April 2008*.

2. ☒ The allowed claim(s) is/are *24-44 [renumbered 1-21]*.

3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☐ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

/Wing F. Chan/
Supervisory Patent Examiner
AU 2619
6/9/08

DETAILED ACTION

Allowable Subject Matter

1. Claims 24-44 are allowed.

2. The following is an examiner's statement of reasons for allowance:

The examiner has not found a cluster router directly connected to 3 other cluster routers in a 3 dimension cluster configuration with 6 [2*n] internal links [See Fig. 4]. The closest art of record, Passint et al. (USP 6,101,181), discloses a router directly connected to 3 other routers in a 3 dimensional configuration plus one more connection to another router using an express link—providing only 4 [n+1] internal links.

3. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

4. Any inquiry concerning this communication or earlier communications from the examiner should be directed to MARK A. MAIS whose telephone number is (571)272-3138. The examiner can normally be reached on M-Th 5am-4pm.

5. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wing F. Chan can be reached on 571-272-7493. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

6. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Wing F. Chan/
Supervisory Patent Examiner, Art Unit 2619
6/9/08

May 20, 2008

/Mark A. Mais/
Examiner, Art Unit 2619

Application Number	Application/Control No.	Applicant(s)/Patent under Reexamination	
	10/625,667	JORDAN ET AL.	
	Examiner	Art Unit	
	MARK A. MAIS	2619	

Index of Claims

Application/Control No.	Applicant(s)/Patent under Reexamination
10/625,667	JORDAN ET AL.
Examiner	**Art Unit**
MARK A. MAIS	2619

√	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

Claim		Date								
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Issue Classification	Application/Control No.	Applicant(s)/Patent under Reexamination	
	10/625,667	JORDAN ET AL.	
	Examiner	Art Unit	
	MARK A. MAIS	2619	

ISSUE CLASSIFICATION

ORIGINAL			CROSS REFERENCE(S)						
CLASS	SUBCLASS	CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)						
370	238	370	235	237					
INTERNATIONAL CLASSIFICATION									
H 0 4 L 12/26									
/									
/									
/									
/									

/Mark A. Mais/ 5/20/2008 (Assistant Examiner) (Date)	/Wing F. Chan/ Supervisory Patent Examiner AU 2619 6/9/08 (Primary Examiner) (Date)	**Total Claims Allowed: 21**
(Legal Instruments Examiner) (Date)		O.G. Print Claim(s): 1 / O.G. Print Fig.: 4

☒ **Claims renumbered in the same order as presented by applicant** ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
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	2	9	32										
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Search Notes

Application/Control No.	Applicant(s)/Patent under Reexamination
10/625,667	JORDAN ET AL.
Examiner	**Art Unit**
MARK A. MAIS	2619

SEARCHED			
Class	Subclass	Date	Examiner
370	235 235.1 236	5/20/2008	MAM
	236.1		
	236.2		
	237 238		
	238.1		
	389 390		
	392 395.1		
	396 395.2		
	395.31		
	411 431		
	432 474		
	475 476		
UPDATED	SEARCH	6/9/2008	MAM

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner
370	**235 237 238**	**5/20/2008**	**MAM**
UPDATED	SEARCH	6/9/2008	MAM

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR
See Inventorship Search	4/18/2007	MAM
See Attached Electronic Search	4/18/2007	MAM
See Attached Electronic Search [updated]	11/15/2007	MAM
See Attached Electronic Search [updated]	5/20/2008	MAM
See Interference Search	5/20/2008	MAM
UPDATED SEARCH	6/9/2008	MAM

EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	2	(("6526055") or ("6965615")).PN.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L2	6849	("725").CLAS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L3	3	(US-6778490-$ or US-6751191-$ or US-5923643-$).did.	USPAT	OR	ON	2008/06/09 00:17
L4	10289	((370/235) or (370/236) or (370/237) or (370/238) or (370/389) or (370/390) or (370/392) or (370/395.1) or (370/396) or (370/395.21) or (370/395.31) or (370/411) or (370/431) or (370/432) or (370/474) or (370/475) or (370/476)).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L5	338	(370/476).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L6	379	(370/475).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L7	1298	(370/474).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L8	494	(370/432).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L9	329	(370/431).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L10	146	(370/411).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L11	246	(370/395.31).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L12	404	(370/395.21).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L13	312	(370/396).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L14	849	(370/395.1).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L15	1881	(370/392).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L16	685	(370/390).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17

L17	2294	(370/389).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L18	532	(370/238).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L19	224	(370/237).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L20	652	(370/236).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L21	1548	(370/235).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L22	3	(("6101192") or ("6965615") or ("6526055")).PN.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L23	2	(("6101192") or ("6965615")).PN.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L24	16	((switch$3) adj (engine $1)) SAME ((router) or (switch)) SAME (redundan $2)	US-PGPUB; USPAT	OR	ON	2008/06/09 00:17
L25	2558	((switch$3) adj (engine $1)) SAME ((router) or (switch))	US-PGPUB; USPAT	OR	ON	2008/06/09 00:17
L26	45	((switch$3) adj (engine $1)) SAME (router)	US-PGPUB; USPAT	OR	ON	2008/06/09 00:17
L27	34	((switching) adj (engine $1)) SAME (router)	US-PGPUB; USPAT	OR	ON	2008/06/09 00:17
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L29	840	((switching) adj (engine))	US-PGPUB; USPAT	OR	ON	2008/06/09 00:17
L30	0	((rotating) adj (symmetric) adj (topology))	US-PGPUB; USPAT	OR	ON	2008/06/09 00:17
L31	0	((rotational) adj (symmetric) adj (topology))	US-PGPUB; USPAT	OR	ON	2008/06/09 00:17
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L42	2294	(370/389).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L43	338	(370/476).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L44	1881	(370/392).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L45	45	((switch$3) adj (engine $1)) SAME (router)	US-PGPUB; USPAT	OR	ON	2008/06/09 00:17
L46	2	(("6101192") or ("6965615")).PN.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L47	312	(370/396).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L48	404	(370/395.21).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L49	246	(370/395.31).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L50	379	(370/475).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L51	146	(370/411).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L52	329	(370/431).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L53	494	(370/432).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17

L54	1298	(370/474).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L55	0	((rotational) adj (symmetric) adj (topology))	USPAT	OR	ON	2008/06/09 00:17
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L57	3	(("6101192") or ("6965615") or ("6526055")).PN.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L58	1548	(370/235).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
L59	34	((switching) adj (engine $1)) SAME (router)	US-PGPUB; USPAT	OR	ON	2008/06/09 00:17
L60	2558	((switch$3) adj (engine $1)) SAME ((router) or (switch))	US-PGPUB; USPAT	OR	ON	2008/06/09 00:17
L61	34	((switching) adj (engine)) SAME (router)	US-PGPUB; USPAT	OR	ON	2008/06/09 00:17
L62	263	((JOHN) near2 (JORDAN)).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2008/06/09 00:17
L63	1	("2005/0018665").URPN.	USPAT	OR	ON	2008/06/09 00:17
L64	0	("2005/0108425").URPN.	USPAT	OR	ON	2008/06/09 00:17
L65	22	((cluster) near3 (router)) SAME (((personal) adj (computer)) or (PC) or (computer))	USPAT	OR	ON	2008/06/09 00:17
L66	1	((cluster) near3 (router)) AND (((personal) adj (computer)) or (PC) or (computer)) AND (toroid $3)	USPAT	OR	ON	2008/06/09 00:17
L67	1	((cluster) near3 (router $1)) AND (toroid$3)	USPAT	OR	ON	2008/06/09 00:17
L68	13	((PETER) near2 (RABINOVITCH)).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2008/06/09 00:17
L69	1	((cluster) near3 (router)) AND (toroid$3)	USPAT	OR	ON	2008/06/09 00:17
L70	175	(router$1) AND (toroid$3)	USPAT	OR	ON	2008/06/09 00:17
L71	0	(router$1) AND ((2n$1) adj (toroid$3))	USPAT	OR	ON	2008/06/09 00:17

L72	22	(router$1) SAME (toroid $3)	USPAT	OR	ON	2008/06/09 00:17
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L75	652	(370/236).CCLS.	USPAT; USOCR	OR	OFF	2008/06/09 00:17
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L78	24	("6101181").URPN.	USPAT	OR	ON	2008/06/09 00:17
L79	15	(US-20050018665-$ or US-20050108425-$).did. or (US-5923643-$ or US-6751191-$ or US-6778490-$ or US-6993034-$ or US-6779039-$ or US-6370584-$ or US-6101181-$ or US-6044080-$ or US-6272548-$ or US-5970232-$ or US-6718428-$ or US-7000033-$ or US-7027413-$).did.	US-PGPUB; USPAT	OR	OFF	2008/06/09 00:17
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L81	0	("7000033").URPN.	USPAT	OR	OFF	2008/06/09 00:17
L82	0	("7027413").URPN.	USPAT	OR	OFF	2008/06/09 00:17

6/9/2008 12:20:43 AM
C:\Documents and Settings\mmais\My Documents\EAST\Workspaces\10,625,667 [5-20-2008].wsp

EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	0	(((switch$2) or (router$1) or (device$1) or (bridge$1) or (gateway$1) or (brouter$1)) AND ((packet$1) or (cell$1) or (frame$1)) AND (network$1) AND (((internal) adj (link$1)) or ((external) adj (link$1)) or (link $1) or (channel $1) or (route $1)) AND ((node $1) or (user$1)) AND ((core) or (edge)) AND (((internal) or (intra)) near2 (connection$1)) AND (dimension $1)).clm.	US-PGPUB	OR	OFF	2008/06/09 00:16

6/9/2008 12:16:43 AM
C:\Documents and Settings\mmais\My Documents\EAST\Workspaces\10,625,667 [Interference Search].wsp

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re U.S. Patent Application of:	)	**Group Art Unit: 2619**
	)	
John Lawrence JORDAN *et al.*	)	**Examiner: M. Mais**
	)	
Serial Number: 10/625,667	)	***Attorney Docket*: JORD3001/BEU**
	)	
Filed: July 24, 2003	)	**Confirmation No.: 8923**

For: Software Based Configurable Cluster-Based Router Using Stock Personal Computers as Cluster Nodes

AMENDMENT AND RESPONSE
(Submitted Concurrently with Request for Continued Examination (RCE))

Honorable Commissioner For Patents
P.O. Box 1450
Alexandria, VA. 22313-1450

Sir:

This paper is in response to the Official Action dated November 29, 2007.

A petition for a two-month extension of time together with the appropriate fee accompanies this response so that it is timely filed. A Request for Continued Examination (RCE) and the appropriate fee also accompany this response.

Amendments to the claims begin on page 2.

Remarks/Arguments begin on page 7.

RCE

REQUEST FOR CONTINUED EXAMINATION (RCE) TRANSMITTAL

Subsection (b) of 35 U.S.C. §132, effective on May 29, 2000, provides for continued examination of an utility or plant application filed on or after June 8, 1995.
See The American Inventors Protection Act of 1999 (AIPA).

Application Number	10/625,667
Filing Date*	July 24, 2003
First Named Inventor	J. L. JORDAN et al
Group Art Unit	2619
Examiner Name	M. Mais
Attorney Docket No.	JORD3001/JZ/BEU

This is a Request for Continued Examination (RCE) under 37 C.F.R. §1.114 of the above-identified application.
NOTE: * Filing date must be on or after June 8, 1995; but if before May 29, 2000, then consider a CPA.

1. Please consider the following as the required submission under 37 C.F.R. §1.114:
   - ☒ a. **The Amendment/Reply filed on (date): FILED CONCURRENTLY HEREWITH**
   - ☐ b. The Information Disclosure Statement (IDS) filed on (date):
   - ☐ c. The arguments in the Brief/Reply Brief filed on (date):
   - ☐ d. The ___ page(s) of Form PTO-1449 and copy of each listed document filed (date):
   - ☐ e. Other:
2. ☒ **A TWO- month Petition for Extension of Time is filed herewith.**
3. ☐ The Commissioner is authorized to credit any overpayment and charge any deficiency in any fees required under 37 CFR 1.16 and/or 1.17 to Deposit Account No. 02-0200.
4. ☒ **A check in the amount of $ $1270 ($810 - RCE/$460 - Petition Fee) is submitted herewith.**
5. ☐ This Request is transmitted by facsimile to number (703) _____.
6. ☐ Other:

THE RCE FEE IS CALCULATED AS FOLLOWS:						Basic Fee:	$810.00
Total Claims:		-		(highest number previously paid for) =		X $50 =	
Independent Claims:		-		(highest number previously paid for) =		X $200 =	
Correspondence Address: 23364 Customer Number						Multiple Dependent Claim (add $360.00):	
						Subtotal:	$810.00
						50% Reduction if Small Entity Status:	
Phone: 703-683-0500			Fax: 703-683-1080			Total:	$810.00

Date:	Name:	Signature:	Reg. No.
April 29, 2008	Jim Zegeer	Jim Zegeer	18,957

RCE -12-9-04.wpd (09Dec04)

04/30/2008 CCHAU1 00000091 10625667
01 FC:1801 810.00 OP

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF: JOHN L. JORDAN ET AL
SERIAL NO.: 10/625,667 GROUP ART UNIT: 2619
FILED: July 24, 2003 EXAMINER: M. Mais
FOR: SOFTWARE BASED CONFIGURABLE CLUSTER-BASED ROUTER USING STOCK PERSONAL COMPUTERS AS CLUSTER NODES ATTY. REFERENCE: JORD3001/BEU

PETITION FOR EXTENSION OF TIME

COMMISSIONER OF PATENTS
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Applicant requests that the time for taking action in this case be extended pursuant to *37 CFR 1.136 (a)* for:

☐ One Month ☐ Three Months
☒ Two Months ☐ Four Months
☐ Five Months

The fee set in *37 CFR 1.17* for the extension of time is **$460**.

☐ Fee enclosed. Please charge any additional fee required for this extension of time to **Deposit Account Number 02-0200**. A duplicate copy of this paper is enclosed.

☒ Charge fee to **Deposit Account Number 02-0200**. A duplicate copy of this paper is enclosed.

☐ Applicant is a **small entity** entitled to pay reduced fees in this application.
A verified small entity statement ☐ has been filed. ☐ is enclosed.

Also enclosed is a:

☒ **Response & RCE** ☐ Notice of Appeal ☐ Appeal Brief

☐

23364
Customer Number
Phone: (703) 683-0500

DATE: April 29, 2008

Respectfully submitted,

Jim Zegeer
Attorney for Applicant
Registration Number: 18,957

04/30/2008 CCHAU1 00000091 10625667
02 FC:1252 460.00 OP

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re U.S. Patent Application of:	)	**Group Art Unit: 2619**
	)	
John Lawrence JORDAN *et al.*	)	**Examiner: M. Mais**
	)	
Serial Number: 10/625,667	)	***Attorney Docket*: JORD3001/BEU**
	)	
Filed: July 24, 2003	)	**Confirmation No.: 8923**

For: Software Based Configurable Cluster-Based Router Using Stock Personal Computers as Cluster Nodes

AMENDMENT AND RESPONSE
(Submitted Concurrently with Request for Continued Examination (RCE))

Honorable Commissioner For Patents
P.O. Box 1450
Alexandria, VA. 22313-1450

Sir:

This paper is in response to the Official Action dated November 29, 2007.

A petition for a two-month extension of time together with the appropriate fee accompanies this response so that it is timely filed. A Request for Continued Examination (RCE) and the appropriate fee also accompany this response.

Amendments to the claims begin on page 2.

Remarks/Arguments begin on page 7.

AMENDMENTS TO CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1-23 (Canceled)

24. (Currently Amended) A software configurable cluster-based router (400) for a packet-switched communication network, said cluster-based router including N cluster nodes (402) connected by a plurality of internal links (404), characterized by:

a plurality of external links for enabling said cluster-based router to exchange traffic with a plurality of nodes of said packet-switched communication network;

each cluster node of said N cluster nodes (402) being adapted to operate as a core router cluster node and as an edge router cluster node;

the internal links (404) connect said cluster nodes in an intra-connection network adapted to provide a high path diversity for a plurality of packet processing flows routed over said intra-connection network between edge router nodes; and

the cluster nodes connected to external links being adapted to operate as edge router cluster nodes,

whereby a specified routing capacity is obtained for said cluster-based router by selecting N and selecting a configuration of said intra-connection network, said configuration having n dimensions, said cluster nodes being interconnected by said internal links in such a way that each of said cluster nodes is connected to two other cluster nodes in each of said dimensions, each of said cluster nodes thereby being connected to 2*n said internal links.

25. (Previously Presented) A software-configurable cluster-based router as claimed in claim 24, wherein each cluster node (402) is a personal computer.

26. (Previously Presented) A software-configurable cluster-based router as claimed in claim 24, wherein said specified configuration comprises an n dimensional topology, each cluster node being connected to 2*n neighboring cluster nodes (402).

27. (Previously Presented) A software-configurable cluster-based router as claimed in claim 24, further comprising:

an additional cluster node (410) adapted to operate as a management node for managing operation of said cluster nodes of said intra-connection network; and

dedicated management links (412) for enabling said additional cluster node to communicate with said cluster nodes.

28. (Previously Presented) A software-configurable cluster-based router as claimed in claim 27, wherein said management links (412) form a star or a bus topology.

29. (Previously Presented) A software-configurable cluster-based router as claimed in claim 24, wherein each cluster node comprises a plurality of routing functional blocks, all said cluster nodes comprising the same routing functional blocks.

30. (Previously Presented) A software-configurable cluster-based router as claimed in claim 24, wherein each cluster node uses an internal addressing process for dynamically determining a node address of each cluster node (402) on said intra-connection network.

31. (Previously Presented) A software-configurable cluster-based router as claimed in claim 24, wherein said cluster nodes use an external addressing process for dynamically determining a router address for said cluster-based router (400) on said communication network.

32. (Previously Presented) A software-configurable cluster-based router as claimed in claim 29, wherein said routing functional blocks comprise:

entry packet processing and routing response processing blocks, adapted to route an untagged packet to an output port of the output ports of said cluster node;

exit packet processing blocks adapted to route a tagged packet to an output port of the output ports of said cluster node;

a packet classification unit connected to input port of said cluster node adapted to route said untagged packet received on said input port over an external link to said entry packet processing and routing response processing blocks, and to route said tagged packet received on said input port over an internal link to said exit packet processing blocks.

33. (Previously Presented) A software-configurable cluster-based router as claimed in claim 32, wherein said entry packet processing and routing response processing blocks includes:

a decision block (506, 510, 520, 533) for determining if said untagged packet needs to be processed at said cluster node; and

a routing response processing block (570) for performing a route lookup on said untagged packet and routing said untagged packet into an output queue corresponding to said output port.

34. (Previously Presented) A software-configurable cluster-based router as claimed in claim 32, wherein said entry packet processing and routing response processing blocks include a tag packet block (540) for attaching a tag to said untagged packet.

35. (Previously Presented) A software-configurable cluster-based router as claimed in claim 34, wherein said exit packet processing blocks include a decision block (580) for determining whether said cluster node is an exit edge cluster node.

36. (Previously Presented) A software-configurable cluster-based router as claimed in claim 34, wherein said exit packet processing blocks include a remove tag block (582) for removing said tag from said tagged packet if said cluster node is an exit edge cluster node.

37. (Previously Presented) software-configurable cluster-based router as claimed in claim 32, further comprising a decision block (510) for determining if said untagged packet is a router management packet and routing said untagged packet to a management node (410) of said cluster based router.

38. (Previously Presented) A software-configurable cluster-based router as claimed in claim 34, wherein said tag is provided as an optional packet header, a packet trailer, or an additional header.

39. (Currently Amended) A method of routing packets over a cluster-based router (400) with a configurable routing capacity and port count, comprising the steps of:

i) selecting a number N and a configuration for said cluster-based router for obtaining a specified routing capacity and port count for said cluster-based router, said configuration having n dimensions, said cluster nodes being interconnected by said internal links in such a way that each of said cluster nodes is connected to two other cluster nodes in each of said dimensions, each of said cluster nodes thereby being connected to 2*n said internal links,

ii) connecting N cluster nodes (402) via internal links in an intra-connection network according to said configuration;

iii) connecting a selected number of cluster nodes designated to operate as edge router cluster nodes over a plurality of external links for enabling connection of said cluster-based router in a communication network; and

iv) routing packets along packet processing flows established between two edge router cluster node over a plurality of core router cluster nodes.

40. (Previously Presented) A method as in claim 39, wherein whenever one of said cluster nodes is affected by a failure, the remaining cluster nodes take over the functionality of said failed cluster node.

41. (Previously Presented) A method as claimed in claim 39, wherein step iv) comprises providing each cluster node with a node MAC address on said intra-connection network, and providing each port of said cluster node with a unique port MAC address.

42. (Previously Presented) A method as claimed in claim 41, wherein said node MAC address is set to the lowest MAC address of all ports of said respective cluster node.

43. (Previously Presented) method as claimed in claim 39 further comprising using a dynamic internal cluster router MAC address determination process for establishing a router MAC address for said cluster-based router.

44. (Previously Presented) A method as claimed in claim 39, wherein step iv) comprises:

attaching a tag to each new packet received on an input port of an edge router cluster node; and

differentially processing packets at each cluster node according to the presence or absence of said tag, whereby:

said packet is routed towards another cluster node if it is addresses to said another cluster node, or said tag is removed and said packet is routed to an edge node for transmission over said communication network.

REMARKS

Reconsideration of the rejection of claims 24-44 under 35 USC §102(b) is respectfully requested on the grounds that U.S. Patent No. 5,970,232 (Passint) clearly does not disclose a cluster configuration having n dimensions in which each cluster node is connected to **two other cluster nodes** in each of the n dimensions, such that each cluster node is connected to other cluster nodes by **2*n internal links**.

The 2*n internal link configuration is illustrated in Fig. 4 of the present application and described, for example, in paragraph [029] of the specification as originally filed:

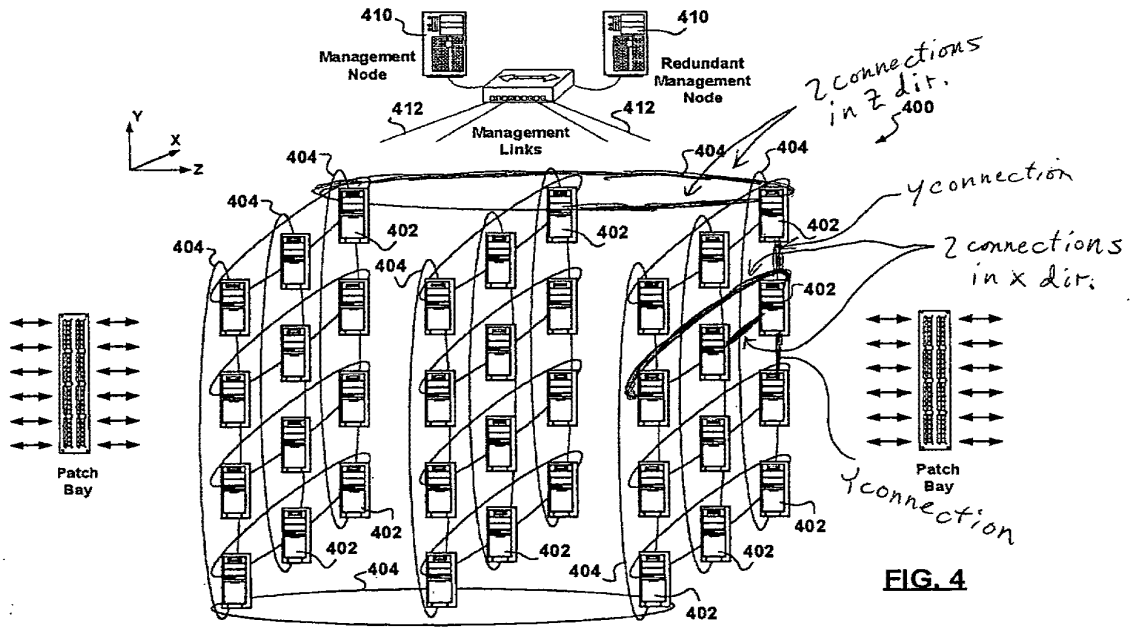

FIG. 4

As illustrated in Fig. 4, each of the nodes 402 is connected to two other nodes in each of three dimensions, with the result that there are six internal connections for each node (3 dimensions * 2 connections).

In contrast, Passint patent discloses one internal interconnection in each dimension plus one additional express link, for a total of three interconnections for each node in a two dimensional configuration (Fig. 4) and four interconnections for each node of a three dimensional configuration (Figs. 5-8), *i.e.*, **n + 1 internal interconnections for each node**. For example, as described in col. 7, lines 17-30 of the Passint patent, Fig. 5 shows a three dimensional configuration in which node 2 is connected to nodes 1, 3, and 5 by three router links RL and to node 7 by an express link EL (links PP are external links to two different routers):

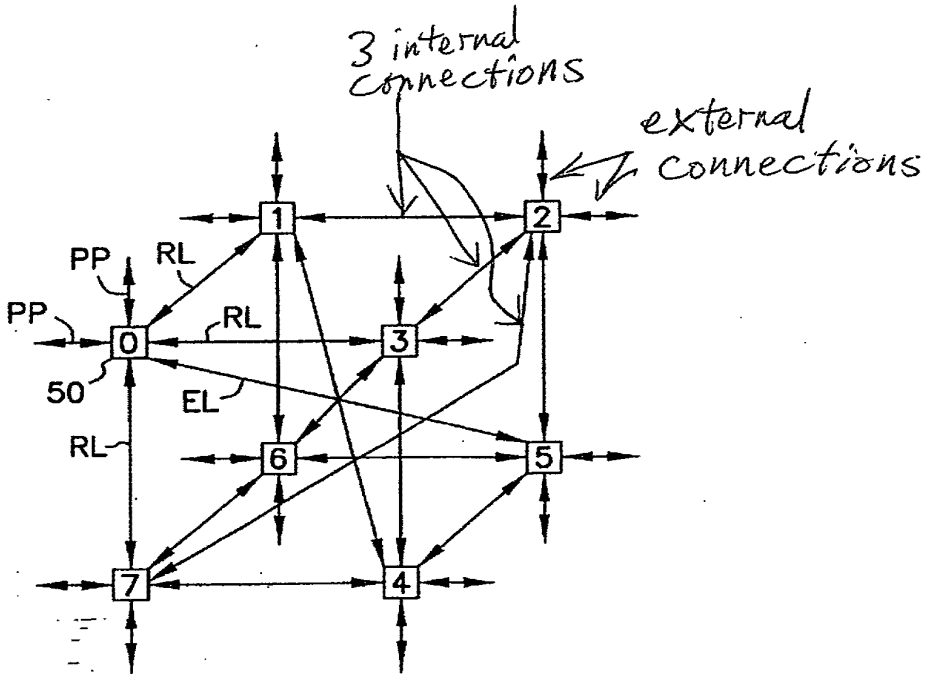

FIG. 5

None of the configurations illustrated in the Passint patent involves a configuration in which each node is connected to **two other nodes *in the same dimension*** and in which each node therefore is connected by **2*n internal links** rather than **n + 1 internal links**.

The differences in the numbers of connections for each node is **not merely a matter of design choice**. Instead, by connecting each cluster node by internal links to just two other nodes in each dimension, the claimed invention achieves a **scalability** that is not possible with the configurations illustrated in the Passint patent, while providing for a high level of **path diversity** to enable internal routing around defective or inoperative nodes. In particular, as explained in paragraph [29] of the present application, it is possible to increase the routing capacity substantially linearly by simply adding n-1 (n minus 1)dimensional slices of router cluster nodes to the "cluster router." In other words, the architecture of the cluster router of the claimed invention has the advantage that increasing the routing capacity does not change in the basic input/output configuration of individual nodes, with the result that the cluster nodes can utilize the same basic programming irrespective of how many cluster nodes are included in the cluster router.

Because the claims now recite a specific cluster router configuration that is not disclosed or suggested by the Passint patent, withdrawal of the outstanding rejection and expedited passage of the application to issue is requested.

Respectfully submitted,

BACON & THOMAS, PLLC

Jim Zegeer

By: Jim Zegeer
Registration No. 18,957

Date: April 29, 2008

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PTO/SB/06 (07-06)
Approved for use through 1/31/2007. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number	Filing Date	☐ To be Mailed
10/625,667	07/24/2003	

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE ($)	SMALL ENTITY FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT 04/29/2008	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE ($)	SMALL ENTITY ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 21	Minus	** 23	= 0	X $ =		OR	X $50=	0
Independent (37 CFR 1.16(h))	* 2	Minus	***3	= 0	X $ =		OR	X $210=	0
☐ Application Size Fee (37 CFR 1.16(s))									
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	0

AMENDMENT	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))									
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/MARCIA J. GORDON/

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/625,667	07/24/2003	John Lawrence Jordan	3437-Z	8923

7590 11/29/2007

Law Office of Jim Zegeer
Suite 108
801 North Pitt Street
Alexandria, VA 22314

EXAMINER	
MAIS, MARK A	
ART UNIT	**PAPER NUMBER**
2619	

MAIL DATE	DELIVERY MODE
11/29/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/625,667	JORDAN ET AL.	
	Examiner	Art Unit	
	Mark A. Mais	2619	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *07 August 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *24-44* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *24-44* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 24-44 are rejected under 35 U.S.C. 102(b) as being anticipated by Passint et al. (USP 6,101,181).

3. With regard to claim 24, Passint et al. discloses a software-based **[inherent]** cluster-based router **[multiprocessor system with a plurality of processing nodes, col. 3, lines 45-47]** for a package-based communication network **[inherent in routers using routing tables]**, said cluster-based router including N cluster nodes **[multiprocessor system with a plurality of processing nodes, col. 3, lines 45-47]** connected by internal links **[an acrylic network is deadlock free, col. 2, lines 64 to col. 3, line 16]**, characterized by

a plurality of external links for enabling said cluster-based router to exchange traffic with a plurality of nodes of said packet-switched communication network **[each router has numerous input/output ports for receiving/sending messages, col. 3, lines 50-54]**;

each cluster node of N cluster nodes being adapted to operate as a core router cluster node and as an edge router cluster node **[torus networks are formed which are scaleable in all n dimensions, col. 1, line 66 to col. 2, line 15; Fig. 8 shows a 6D hypercube topology multiprocessor system, col. 8, lines 19-31; inter-nodal network redundancy is interpreted as an edge routing redundancy, Abstract]**;

the internal links connect said cluster nodes in an intra-connection network adapted to provide high path diversity for a plurality of packet processing flows routed over said intra-connection network between edge router cluster nodes **[an acrylic network is deadlock free, col. 2, lines 64 to col. 3, line 16]**;

the cluster nodes connected to external links being adapted to operate as edge router cluster nodes **[each router has numerous input/output ports for receiving/sending messages, col. 3, lines 50-54; inter-nodal network redundancy is interpreted as an edge routing redundancy, Abstract]**;

whereby a specified routing capacity is obtained for said cluster-based router by selecting a configuration of said intra-connection network **[torus networks are formed which are scaleable in all n dimensions, col. 1, line 66 to col. 2, line 15; Fig. 8 shows a 6D hypercube topology multiprocessor system, col. 8, lines 19-31; each formed network provides a specified routing capacity]**.

4. With regard to claim 25, Passint et al. discloses that each router cluster node is a personal computer **[a desktop computer system (interpreted as a personal computer), col. 8, lines 33-34]**.

5. With regard to claim 26, Passint et al. discloses that the specified configuration comprises an n dimensional topology , each cluster node being connected to 2*n neighboring router cluster nodes **[torus networks are formed which are scaleable in all n dimensions, col. 1, line 66 to col. 2, line 15; Fig. 8 shows a 6D hypercube topology multiprocessor system, col. 8, lines 19-31]**.

6. With regard to claim 27, Passint et al. discloses

an additional cluster node adapted to operate as a management node for managing operation of said cluster nodes of said intra-connection network **[with torus/hypercube topologies, multiple available paths allow the system to bypass broken processors or links, col. 19, line 50 to col. 20, line 13; each router is interpreted as a management node when it is routing a message; thus, it must route the message to the correct destination despite broken processors or links]**; and

dedicated management links for enabling additional cluster node to communicate with said cluster nodes **[Fig. 9 shows a system where each cluster has six links to six neighboring nodes, col. 8, lines 52-58 (claim 16); side-band signaling is interpreted as dedicated links, col. 12, lines 12-22]**.

7. With regard to claim 28, Passint et al. discloses that the management links form a star **[star, mesh, ring, etc. col. 1, lines 43-45]** or bus topology.

8. With regard to claim 29, Passint et al. discloses that each cluster node comprises a plurality of routing function **[interpreted as routing table functionality]** blocks, all of said cluster nodes comprising the same routing function blocks **[the global routing table and the local routing tables provide both processor and link functionality (operating status) reporting, col. 13, line 20 to col. 14, line 34; for example, fault avoidance is provided (col. 13, lines 38-40)]**.

9. With regard to claim 30, Passint et al. discloses that each cluster node uses an internal addressing process for dynamically determining a node address of each cluster node of said intra-connection network **[the global routing table (external addressing) and the local routing tables (internal tag/addressing; especially for a series of same-tagged/addressed packets) provide both processor and link functionality (operating status) reporting, col. 13, line 20 to col. 14, line 34; for example, fault avoidance is provided (col. 13, lines 38-40)]**.

10. With regard to claim 31, Passint et al. discloses that the cluster nodes use an external addressing process for dynamically determining a router address for said cluster-based router on said communication network **[the global routing table (external addressing) and the local routing tables (internal tag/addressing; especially for a series of same-tagged/addressed packets) provide both processor and link functionality (operating status) reporting, col. 13, line 20 to col. 14, line 34; for example, fault avoidance is provided (col. 13, lines 38-40)]**.

11. With regard to claim 32, Passint et al. discloses that the routing functional blocks comprise:

entry packet processing and routing response processing blocks, adapted to route an untagged packet to an output port of the output ports of said cluster node; exit packet processing blocks adapted to route a tagged packet to an output port of the output ports of said cluster node **[the global routing table (external addressing) and the local routing tables (internal addressing; also internal tag/addressing; especially for a series of same-tagged/addressed packets) provide both processor and link functionality (operating status) reporting, col. 13, line 20 to col. 14, line 34; for example, fault avoidance is provided (col. 13, lines 38-40)]**;

a packet classification unit connected to input port of said cluster node adapted to route said untagged packet received on said input port over an external link to said entry packet processing and routing response processing blocks, and to route said tagged packet received on said input port over an internal link to said exit packet processing blocks **[each router has numerous input/output ports for receiving/sending messages, col. 3, lines 50-54; torus networks are formed which are scaleable in all n dimensions, col. 1, line 66 to col. 2, line 15; Fig. 8 shows a 6D hypercube topology multiprocessor system, col. 8, lines 19-31; Fig. 9 shows a system where each cluster has six links to six neighboring nodes, col. 8, lines 52-58]**.

12. With regard to claim 33, Passint et al. discloses that the entry processing and routing response blocks include

a decision block for determining if said untagged packet needs to be processed at the cluster node **[inherent if the cluster node handle same-tagged packets]**; and a routing response processing block for performing a route lookup on said untagged packet and routing said untagged packet and routing said untagged packet into an output queue corresponding to said output port **[the global routing table (external addressing) and the local routing tables (internal tag/addressing; especially for a series of same-tagged/addressed packets) provide both processor and link functionality (operating status) reporting, col. 13, line 20 to col. 14, line 34; for example, fault avoidance is provided (col. 13, lines 38-40)]**.

13. With regard to claim 34, Passint et al. discloses that the entry packet processing and routing response processing blocks include a tag packet block and an attaching a tag to said untagged packet **[with torus/hypercube topologies, multiple available paths allow the system to bypass broken processors or links, col. 19, line 50 to col. 20, line 13; thus, it must route the message to the correct destination despite broken processors or links; this is interpreted as necessarily tagging a packet; e.g., the router tries to match the global ID first to look up in the global table; if unsuccessful, it looks to the local router table (interpreted as encapsulated within one another), col. 15, lines 41-55]**.

14. With regard to claim 35, Passint et al. discloses that the exit processing blocks include a decision block for determining whether said cluster node is a exit edge cluster node **[inherent if the cluster node can use both external addressing and internal addressing]**.

15. With regard to claim 36, Passint et al. discloses that the exit processing blocks includes a tag remove block for removing said tag from said tagged packet if said cluster node is an exit edge cluster node **[inherent if the cluster node can use both external addressing and internal addressing]**.

16. With regard to claim 37, Passint et al. discloses a decision block for determining if said untagged packet is a router management packet and routing said untagged packet to a management node of said cluster based router **[with torus/hypercube topologies, multiple available paths allow the system to bypass broken processors or links, col. 19, line 50 to col. 20, line 13; each router is interpreted as a management node when it is routing a message; thus, it must route the message to the correct destination despite broken processors or links; Fig. 9 shows a system where each cluster has six links to six neighboring nodes, col. 8, lines 52-58; side-band signaling is interpreted as dedicated links for routing router management packets, col. 12, lines 12-22]**.

17. With regard to claim 38, Passint et al. discloses that each tag is provided as either

an optional packet header **[sideband signaling, col. 12, lines 12-22]**,

a packet trailer [**tail micropackets, col. 12, lines 5-8**], or

an additional header encapsulating the associated packet having cluster router relevance only **[the router tries to match the global ID first to look up in the global table; if unsuccessful, it looks to the local router table (interpreted as encapsulated within one another), col. 15, lines 41-55]**.

18. With regard to claim 39, Passint et al. discloses a method of routing packets over a cluster-based router **[multiprocessor system with a plurality of processing nodes, col. 3, lines 45-47]** with configurable routing capacity and port count **[inherent to routers; e.g., each router has numerous input/output ports for receiving/sending messages, col. 3, lines 50-54]** comprising the steps of:

selecting a number N **[multiprocessor system with a plurality of processing nodes, col. 3, lines 45-47]** and a configuration for said cluster-based router for obtaining a specified routing capacity and port count for said cluster-based router **[torus networks are formed which are scaleable in all n dimensions, col. 1, line 66 to col. 2, line 15; Fig. 8 shows a 6D hypercube topology multiprocessor system, col. 8, lines 19-31; each formed network provides a specified routing capacity]**;

connecting N cluster nodes via internal links in an intra-connection network according to said cluster-based router **[an acrylic network is deadlock free, col. 2, lines 64 to col. 3, line 16]**;

connected a selected number of cluster nodes designated to operate as edge router cluster nodes over a plurality of external links for enabling connection of said cluster-based router in a communication network **[torus networks are formed which are scaleable in all n dimensions, col. 1, line 66 to col. 2, line 15; Fig. 8 shows a 6D hypercube topology multiprocessor system, col. 8, lines 19-31; inter-nodal network redundancy is interpreted as an edge routing redundancy, Abstract]**; and

routing packets along packet processing flows established between edge router cluster node over a plurality of core router cluster nodes **[each router has numerous input/output ports for receiving/sending messages, col. 3, lines 50-54; torus networks are formed which are scaleable in all n dimensions, col. 1, line 66 to col. 2, line 15; Fig. 8 shows a 6D hypercube topology multiprocessor system, col. 8, lines 19-31; inter-nodal network redundancy is interpreted as an edge routing redundancy, Abstract]**.

19. With regard to claim 40, Passint et al. discloses that whenever one of said cluster nodes is affected by failure, the remaining cluster nodes take over the functionality of the failed cluster node **[with torus/hypercube topologies, multiple available paths allow the system to bypass broken processors or links, col. 19, line 50 to col. 20, line 13; each router is interpreted as a management node when it is routing a message (claim 17); thus, it must route the message to the correct destination despite broken processors or links]**.

20. With regard to claim 41, Passint et al. discloses using a node MAC address in the intra-connection network and providing each said cluster node with a unique MAC address **[this is inherent to packet-based routing (e.g., TCP/IP routinely using unique MAC addresses)]**.

21. With regard to claim 44, Passint et al. discloses

attaching a tag to each new packet received on an input port of an edge router cluster node **[with torus/hypercube topologies, multiple available paths allow the system to bypass broken processors or links, col. 19, line 50 to col. 20, line 13; thus, it must route the message**

to the correct destination despite broken processors or links; this is interpreted as necessarily tagging a packet; e.g., the router tries to match the global ID first to look up in the global table; if unsuccessful, it looks to the local router table (interpreted as encapsulated within one another), col. 15, lines 41-55]; and

differentially processing packets at each cluster node according to the presence or absence of said tag, whereby said packet is routed towards another cluster node if it is addressed to said another cluster node, or said tag is removed and said packet is routed to an edge node for trans mission over said communication network **[the global routing table (external addressing) and the local routing tables (internal tag/addressing; especially for a series of same-tagged/addressed packets) provide both processor and link functionality (operating status) reporting, col. 13, line 20 to col. 14, line 34; for example, fault avoidance is provided (col. 13, lines 38-40)]**.

Claim Rejections - 35 USC § 103

22. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

23. Claims 42-43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Passint et al.

24. With regard to claims 42-43, Passint et al. does not specifically disclose that the node MAC address is set to the lowest MAC address of all ports of said respective cluster node. First, it is inherent to packet-based routing that MAC addresses can be used [e.g., the MAC addresses used in TCP/IP]. Second, Applicants have not disclosed that changing the order of MAC addresses from lowest to highest (as opposed, for example, from highest to lowest) solves any stated problem or is for any particular purpose. It appears that the performance of the setting the MAC address of the router cluster to lowest possible MAC address would result equally well with the internal addressing methodology already disclosed in Passint et al. It is known to those in the art that such a determination must necessarily be dynamic [claim 43]. Accordingly, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Passint et al. to use the internal MAC addressing methodology for the cluster-based routers because such modifications are considered a mere design choice consideration, which fails to patentably distinguish over the prior art of Passint et al. In addition, changing the order of internal MAC addresses [(a) starting from the lowest MAC address versus (b) any MAC address or (c) starting with the highest MAC address] is interpreted as an optimum value for a known process. A discovery of an optimum value for a known process is obvious engineering. *See* In re Aller, 105 USPQ 233 (CCPA 1955).

Response to Arguments

25. Applicant's arguments filed have been fully considered but they are not persuasive.

26. With respect to claims 24 and 39, Applicant argues that Passint et al. fails to disclose a physically connected 12-toroidal cluster node **[See Applicant's Amendment dated August 7, 2007, page 7 paragraph 2 to page 10, paragraph 5]**. The examiner respectfully disagrees.

27. First, in response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., a physically connected 12-toroidal cluster node) are not recited in the rejected claims. Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

28. Second, the examiner currently understands that a limitation such as a physically connected 12-toroidal cluster node is not specific enough to not be rendered obvious by the Passint et al. reference. For example, as understood by the examiner, it fails to claim the exact physical connections present and how this is different form the Passint et al reference.

Conclusion

29. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

30. A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

31. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

(a) Lee et al. (USP 6,718,428), Storage array interconnection fabric using a torus topology. This reference shows a balanced toroidal cluster.

(b) Lee (USP 7,000,033), Mapping of nodes in an interconnection fabric. This reference shows a balanced toroidal cluster.

(c) Lee et al. (USP 7,027,413), Discovery of nodes in an interconnection fabric. This reference shows a balanced toroidal cluster.

32. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mark A. Mais whose telephone number is 572-272-3138. The examiner can normally be reached on M-Th 5am-4pm.

33. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wing F. Chan can be reached on 571-272-7493. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

34. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

MAM
November 15, 2007

11/26/07
WING CHAN
SUPERVISORY PATENT EXAMINER

Notice of References Cited	Application/Control No. 10/625,667	Applicant(s)/Patent Under Reexamination JORDAN ET AL.	
	Examiner Mark A. Mais	Art Unit 2619	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-6,718,428	04-2004	Lee et al.	711/101
*	B	US-7,000,033	02-2006	Lee, Whay S.	709/249
*	C	US-7,027,413	04-2006	Lee et al.	370/255
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
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	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims

Application/Control No.	Applicant(s)/Patent under Reexamination
10/625,667	JORDAN ET AL.
Examiner	**Art Unit**
Mark A. Mais	2619

√	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

Claim		Date							
Final	Original	4/18/07	11/15/07						
	1	√	–						
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Search Notes	Application/Control No.	Applicant(s)/Patent under Reexamination
	10/625,667	JORDAN ET AL.
	Examiner	Art Unit
	Mark A. Mais	2619

SEARCHED			
Class	Subclass	Date	Examiner
370	235-238 238.1	4/18/2007	MAM
	389 390		
	392 395.1		
	396 395.21		
	395.31 411		
	432 431		
	474 475 476		
SAME AS	ABOVE	11/15/2007	MAM

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR
See Inventorship Search	4/18/2007	MAM
See Attached Electronic Search	4/18/2007	MAM
See Attached Electronic Search [updated]	11/15/2007	MAM

EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	2	(("6526055") or ("6965615")).PN.	USPAT; USOCR	OR	OFF	2007/11/26 01:58
L2	6520	("725").CLAS.	USPAT; USOCR	OR	OFF	2007/11/26 01:58
L3	3	(US-6778490-$ or US-6751191-$ or US-5923643-$).did.	USPAT	OR	ON	2007/11/26 01:58
L4	9458	((370/235) or (370/236) or (370/237) or (370/238) or (370/389) or (370/390) or (370/392) or (370/395.1) or (370/396) or (370/395.21) or (370/395.31) or (370/411) or (370/431) or (370/432) or (370/474) or (370/475) or (370/476)).CCLS.	USPAT; USOCR	OR	OFF	2007/11/26 01:58
L5	314	(370/476).CCLS.	USPAT; USOCR	OR	OFF	2007/11/26 01:58
L6	366	(370/475).CCLS.	USPAT; USOCR	OR	OFF	2007/11/26 01:58
L7	1215	(370/474).CCLS.	USPAT; USOCR	OR	OFF	2007/11/26 01:58
L8	455	(370/432).CCLS.	USPAT; USOCR	OR	OFF	2007/11/26 01:58
L9	312	(370/431).CCLS.	USPAT; USOCR	OR	OFF	2007/11/26 01:58
L10	141	(370/411).CCLS.	USPAT; USOCR	OR	OFF	2007/11/26 01:58
L11	224	(370/395.31).CCLS.	USPAT; USOCR	OR	OFF	2007/11/26 01:58
L12	370	(370/395.21).CCLS.	USPAT; USOCR	OR	OFF	2007/11/26 01:58
L13	300	(370/396).CCLS.	USPAT; USOCR	OR	OFF	2007/11/26 01:58
L14	817	(370/395.1).CCLS.	USPAT; USOCR	OR	OFF	2007/11/26 01:58
L15	1673	(370/392).CCLS.	USPAT; USOCR	OR	OFF	2007/11/26 01:58
L16	623	(370/390).CCLS.	USPAT; USOCR	OR	OFF	2007/11/26 01:58
L17	2085	(370/389).CCLS.	USPAT; USOCR	OR	OFF	2007/11/26 01:58
L18	484	(370/238).CCLS.	USPAT; USOCR	OR	OFF	2007/11/26 01:58

EAST Search History

L19	199	(370/237).CCLS.	USPAT; USOCR	OR	OFF	2007/11/26 01:58
L20	606	(370/236).CCLS.	USPAT; USOCR	OR	OFF	2007/11/26 01:58
L21	1371	(370/235).CCLS.	USPAT; USOCR	OR	OFF	2007/11/26 01:58
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L27	33	((switching) adj (engine$1)) SAME (router)	US-PGPUB; USPAT	OR	ON	2007/11/26 01:58
L28	33	((switching) adj (engine)) SAME (router)	US-PGPUB; USPAT	OR	ON	2007/11/26 01:58
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EAST Search History

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L56	6520	("725").CLAS.	USPAT; USOCR	OR	OFF	2007/11/26 01:58
L57	3	(("6101192") or ("6965615") or ("6526055")).PN.	USPAT; USOCR	OR	OFF	2007/11/26 01:58
L58	1371	(370/235).CCLS.	USPAT; USOCR	OR	OFF	2007/11/26 01:58

EAST Search History

L59	33	((switching) adj (engine$1)) SAME (router)	US-PGPUB; USPAT	OR	ON	2007/11/26 01:58
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L61	33	((switching) adj (engine)) SAME (router)	US-PGPUB; USPAT	OR	ON	2007/11/26 01:58
L62	261	((JOHN) near2 (JORDAN)).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2007/11/26 01:58
L63	1	("2005/0018665").URPN.	USPAT	OR	ON	2007/11/26 01:58
L64	0	("2005/0108425").URPN.	USPAT	OR	ON	2007/11/26 01:58
L65	20	((cluster) near3 (router)) SAME (((personal) adj (computer)) or (PC) or (computer))	USPAT	OR	ON	2007/11/26 01:58
L66	1	((cluster) near3 (router)) AND (((personal) adj (computer)) or (PC) or (computer)) AND (toroid$3)	USPAT	OR	ON	2007/11/26 01:58
L67	1	((cluster) near3 (router$1)) AND (toroid$3)	USPAT	OR	ON	2007/11/26 01:58
L68	12	((PETER) near2 (RABINOVITCH)).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2007/11/26 01:58
L69	1	((cluster) near3 (router)) AND (toroid$3)	USPAT	OR	ON	2007/11/26 01:58
L70	155	(router$1) AND (toroid$3)	USPAT	OR	ON	2007/11/26 01:58
L71	0	(router$1) AND ((2n$1) adj (toroid$3))	USPAT	OR	ON	2007/11/26 01:58
L72	22	(router$1) SAME (toroid$3)	USPAT	OR	ON	2007/11/26 01:58
L73	133	L70 not L72	USPAT	OR	ON	2007/11/26 01:58
L74	199	(370/237).CCLS.	USPAT; USOCR	OR	OFF	2007/11/26 01:58
L75	606	(370/236).CCLS.	USPAT; USOCR	OR	OFF	2007/11/26 01:58
L76	0	((rotational) adj (symmetric) adj (topology))	US-PGPUB; USPAT	OR	ON	2007/11/26 01:58
L77	12	(US-20050018665-$ or US-20050108425-$).did. or (US-5923643-$ or US-6751191-$ or US-6778490-$ or US-6993034-$ or US-6779039-$ or US-6370584-$ or US-6101181-$ or US-6044080-$ or US-6272548-$ or US-5970232-$). did.	US-PGPUB; USPAT	OR	ON	2007/11/26 02:01
L78	21	("6101181").URPN.	USPAT	OR	ON	2007/11/26 04:44

VIA FACSIMILE - 11 SHEETS
TO FAX NO. 571-273-8300

Atty. Docket No.: 3437-Z

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of
John Lawrence Jordan et al
Application No. 10/625,667
Filed: July 24, 2003
For: Software Configurable Cluster-Based Router Using Stock Personal Computers as Cluster Nodes

Art Unit 2616
Examiner Mark A. Mais

AMENDMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In response to the Official Action mailed May 9, 2007, please amend the above-identified application as follows:

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Claims 1 - 23 (CANCELLED).

24. (NEW) A software configurable cluster-based router (400) for a packet-switched communication network, said cluster-based router including N cluster nodes (402) connected by a plurality of internal links (404), characterized by:

a plurality of external links for enabling said cluster-based router to exchange traffic with a plurality of nodes of said packet-switched communication network;

each cluster node of said N cluster nodes (402) being adapted to operate as a core router cluster node and as an edge router cluster node;

the internal links (404) connect said cluster nodes in an intra-connection network adapted to provide a high path diversity for a plurality of packet processing flows routed over said intra-connection network between edge router nodes; and

the cluster nodes connected to external links being adapted to operate as edge router cluster nodes,

whereby a specified routing capacity is obtained for said cluster-based router by selecting N and selecting a configuration of said intra-connection network.

25. (NEW) A software-configurable cluster-based router as claimed in claim 24, wherein each cluster node (402) is a personal computer.

26. (NEW) A software-configurable cluster-based router as claimed in claim 24, wherein said specified configuration

comprises an n dimensional topology, each cluster node being connected to 2*n neighboring cluster nodes (402).

27. (NEW) A software-configurable cluster-based router as claimed in claim 24, further comprising:

an additional cluster node (410) adapted to operate as a management node for managing operation of said cluster nodes of said intra-connection network; and

dedicated management links (412) for enabling said additional cluster node to communicate with said cluster nodes.

28. (NEW) A software-configurable cluster-based router as claimed in claim 27, wherein said management links (412) form a star or a bus topology.

29. (NEW) A software-configurable cluster-based router as claimed in claim 24, wherein each cluster node comprises a plurality of routing functional blocks, all said cluster nodes comprising the same routing functional blocks.

30. (NEW) A software-configurable cluster-based router as claimed in claim 24, wherein each cluster node uses an internal addressing process for dynamically determining a node address of each cluster node (402) on said intra-connection network.

31. (NEW) A software-configurable cluster-based router as claimed in claim 24, wherein said cluster nodes use an external addressing process for dynamically determining a router address for said cluster-based router (400) on said communication network.

32. (NEW) A software-configurable cluster-based router as claimed in claim 29, wherein said routing functional blocks comprise:

entry packet processing and routing response processing blocks, adapted to route an untagged packet to an output port of the output ports of said cluster node;

exit packet processing blocks adapted to route a tagged packet to an output port of the output ports of said cluster node;

a packet classification unit connected to input port of said cluster node adapted to route said untagged packet received on said input port over an external link to said entry packet processing and routing response processing blocks, and to route said tagged packet received on said input port over an internal link to said exit packet processing blocks.

33. (NEW) A software-configurable cluster-based router as claimed in claim 32, wherein said entry packet processing and routing response processing blocks includes:

a decision block (506, 510, 520, 533) for determining if said untagged packet needs to be processed at said cluster node; and

a routing response processing block (570) for performing a route lookup on said untagged packet and routing said untagged packet into an output queue corresponding to said output port.

34. (NEW) A software-configurable cluster-based router as claimed in claim 32, wherein said entry packet processing and routing response processing blocks include a tag packet block (540) for attaching a tag to said untagged packet.

35. (NEW) A software-configurable cluster-based router as claimed in claim 34, wherein said exit packet processing blocks include a decision block (580) for determining whether said cluster node is an exit edge cluster node.

36. (NEW) A software-configurable cluster-based router as claimed in claim 34, wherein said exit packet processing blocks

include a remove tag block (582) for removing said tag from said tagged packet if said cluster node is an exit edge cluster node.

37. (NEW) A software-configurable cluster-based router as claimed in claim 32, further comprising a decision block (510) for determining if said untagged packet is a router management packet and routing said untagged packet to a management node (410) of said cluster based router.

38. (NEW) A software-configurable cluster-based router as claimed in claim 34, wherein said tag is provided as an optional packet header, a packet trailer, or an additional header.

39. (NEW) A method of routing packets over a cluster-based router (400) with a configurable routing capacity and port count, comprising the steps of:

i) selecting a number N and a configuration for said cluster-based router for obtaining a specified routing capacity and port count for said cluster-based router,

ii) connecting N cluster nodes (402) via internal links in an intra-connection network according to said configuration;

iii) connecting a selected number of cluster nodes designated to operate as edge router cluster nodes over a plurality of external links for enabling connection of said cluster-based router in a communication network; and

iv) routing packets along packet processing flows established between two edge router cluster node over a plurality of core router cluster nodes.

40. (NEW) A method as in claim 39, wherein whenever one of said cluster nodes is affected by a failure, the remaining cluster nodes take over the functionality of said failed cluster node.

41. (NEW) A method as claimed in claim 39, wherein step iv) comprises providing each cluster node with a node MAC address on said intra-connection network, and providing each port of said cluster node with a unique port MAC address.

42. (NEW) A method as claimed in claim 41, wherein said node MAC address is set to the lowest MAC address of all ports of said respective cluster node.

43. (NEW) A method as claimed in claim 39 further comprising using a dynamic internal cluster router MAC address determination process for establishing a router MAC address for said cluster-based router.

44. (NEW) A method as claimed in claim 39, wherein step iv) comprises:

attaching a tag to each new packet received on an input port of an edge router cluster node; and

differentially processing packets at each cluster node according to the presence or absence of said tag, whereby:

said packet is routed towards another cluster node if it is addresses to said another cluster node, or said tag is removed and said packet is routed to an edge node for transmission over said communication network.

REMARKS/ARGUMENTS

Claims 1 - 23 have been cancelled and replaced by new claims 24 - 44. Claims 24 - 44 are the claims pending in the application. It will noted that these new claims are in European format and that they are patterned on the claims that are on file in the corresponding European application.

Traversal of the prior art rejections

The rejection of claims 1 - 23 under 35 U.S.C. 102(b) as being anticipated by Passint et al (US 6,101,181) (hereinafter Passint) is respectfully traversed. The Passint patent deals with multiprocessor computer systems having up to hundreds of thousands of processing elements or nodes and referred to as massively parallel processing (MPP) systems. In a typical multiprocessor MPP system, every processing element can directly address all of memory, including the memory of another (remote) processing element, without involving the processor at that processing element. Instead of treating processing element-to-remote-memory communications as an I/O operation, reads or writes to another processing element's memory are accomplished in the same manner as reads or writes to the local memory. (Col. 1, lines 25-37, BACKGROUND OF THE INVENTION.)

The Passint reference deals with:

> Multiprocessor computer systems having up to hundreds or thousands of processing element nodes are typically referred to as massively parallel processing (MPP) systems. In a typical multiprocessor MPP system, every

> processing element can directly address all of memory, including the memory of another (remote) processing element, without involving the processor at that processing element. (Passint, first paragraph under "Background of the Invention," emphasis added).

The disclosure deals with torus topology which is a ring formed in each dimension and can transfer from one node to all of the nodes in the same dimension and back to the original node. (Passint, paragraph bridging cols. 1 and 2.) In the "Summary of the Invention," Passint points out that:

> Each processing element node has at least one processor and memory. Physical communication links interconnect the processing element nodes in a n-dimensional topology. Routers route messages between the plurality of processing element nodes on the physical communication links. Each router includes input ports for receiving messages, output ports for sending messages from the router, two types of virtual channels, a lookup table associated with the input port having a lookup table virtual channel number, and a virtual channel assignment mechanism. Each type of virtual channel has virtual channel buffers assigned to each physical communication link and is capable of storing messages communicated between the processing element nodes over the physical communication links. The virtual channel assignment mechanism assigns an output next virtual channel number for determining the type of virtual channel to be used for routing from a next router along a given route. The next virtual channel number is assigned based on the lookup table virtual channel number and an input next virtual channel number received from a previously router along the given route. (Passint, first paragraph in the "Summary of the Invention", col. 3, lines 47-67.)

Fig. 8 of Passint referred to by the Examiner is described in col. 8 as the following:

> An example six dimensional (6D) hypercube topology multiprocessor system is modeled in Fig. 8. In Fig. 8, 64 router chips 50 are employed. There are two processor ports from each router, such as those labeled PP from router 0, to couple each router to two nodes to create a double bristled topology. Thus the doubled bristled 6D

topology produces a 128 node multiprocessor system having 256 processors in a two processor per node system or 512 processors in a four processor per node system. The router links, such as those labeled RL from node 0 form the 6D hypercube topology. For clarity, only the node 0 links in the fourth, fifth, and sixth dimensions are shown in Fig. 7.

Fig. 8 of Passint is shown side-by-side of applicants' Fig. 4 as follows:

Passint

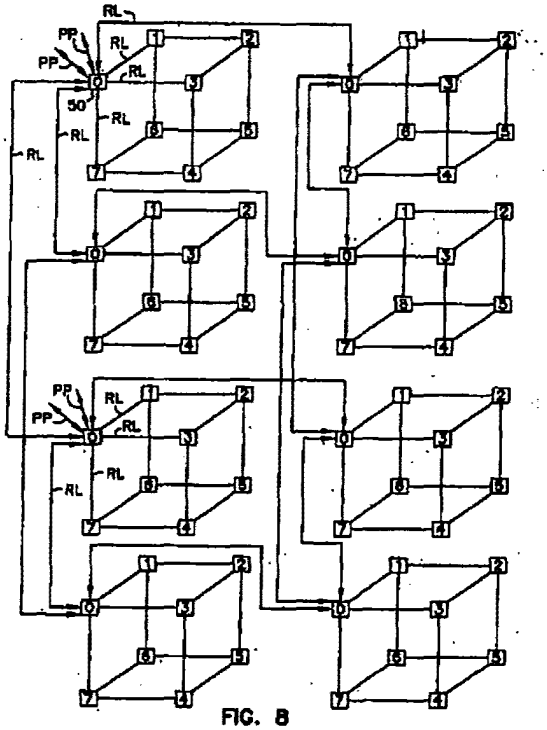

FIG. 8

Applicants

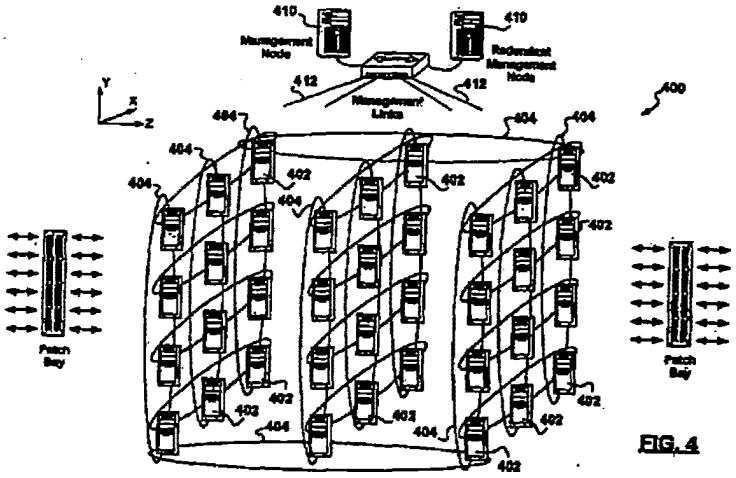

FIG. 4

In contrast, applicants' Fig. 4 is an exemplary embodiment showing the individual clustered nodes 402 arranged in x, y and z slices with each router cluster node 402 physically connected via 404 to adjacent router cluster nodes 402 in the x, y and z

directions. Only the two z-toroidal interconnections are shown in order to improve clarity. However, every router cluster node 402 participates in a z-toroid of which there are twelve in total. The toroidal interconnections 404 implement a dedicated cluster intra-connection network. This is reflected in applicants' claim 24 in the following:

> ...a plurality of external links for enabling said cluster-based router to exchange traffic with a plurality of nodes of said packet-switched communication network;
> each cluster node of said N cluster nodes (402) being adapted to operate as a core router cluster node and as an edge router cluster node;
> the internal links (404) connect said cluster nodes in an intra-connection network adapted to provide a high path diversity for a plurality of packet processing flows routed over said intra-connection network between edge router nodes; and
> the cluster nodes connected to external links are adapted to operate as edge router cluster nodes,
> whereby a specified routing capacity is obtained for said cluster-based router by selecting N and selecting a configuration of said intra-connection network.

This is not disclosed or suggested by the art.

New method claim 39 reads:

> ...i) selecting a number N and a configuration for said cluster-based router for obtaining a specified routing capacity and port count for said cluster-based router,
> ii) connecting N cluster nodes (402) via internal links in an intra-connection network according to said configuration;
> iii) connecting a selected number of cluster nodes designated to operate as edge router cluster nodes over a plurality of external links for enabling connection of said cluster-based router in a communication network; and
> iv) routing packets along packet processing flows established between two edge router cluster node over a plurality of core router cluster nodes.

This is likewise not disclosed or suggested in the Passint art.

In view of the above, further and favorable reconsideration is respectfully requested.

Respectfully submitted,

Jim Zegeer

Jim Zegeer, Reg. No. 18,957
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Alexandria, VA 22314

Telephone: 703-684-8333

Date: August 7, 2007

In the event this paper is deemed not timely filed, the applicant hereby petitions for an appropriate extension of time. The fee for this extension may be charged to Deposit Account No. 26-0090 along with any other additional fees which may be required with respect to this paper.

CERTIFICATE OF TRANSMISSION/MAILING

I hereby certify that this correspondence is being facsimile transmitted to the USPTO or deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date shown below:

Signature: Jim Zegeer
Jim Zegeer

Date: Aug 7 2007

PATENT APPLICATION FEE DETERMINATION RECORD
Effective January 1, 2003

Application or Docket Number: 10/625,667

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS	23	
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	23 minus 20=	* 3
INDEPENDENT CLAIMS	3 minus 3 =	* 0
MULTIPLE DEPENDENT CLAIM PRESENT		☐

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☐		OR	OTHER THAN SMALL ENTITY	
RATE	FEE		RATE	FEE
BASIC FEE	375.00	OR	BASIC FEE	750.00
X$ 9=		OR	X$18= 54.	
X42=		OR	X84=	
+140=		OR	+280=	
TOTAL		OR	TOTAL	804

CLAIMS AS AMENDED - PART II

8-7-07

AMENDMENT A	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 21	Minus	** 23	= 0
Independent	* 2	Minus	*** 3	= 0
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18= 0	
X42=		OR	X84= 0	
+140=		OR	+280= 0	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	0

AMENDMENT B	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X42=		OR	X84=	
+140=		OR	+280=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X42=		OR	X84=	
+140=		OR	+280=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

FORM PTO-875 (Rev. 12/02) U.S. Government Printing Office: 2003 — 499-276/59151 Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/625,667	07/24/2003	John Lawrence Jordan	3437-Z	8923

7590 05/09/2007

Law Office of Jim Zegeer
Suite 108
801 North Pitt Street
Alexandria, VA 22314

EXAMINER	
MAIS, MARK A	

ART UNIT	PAPER NUMBER
2616	

MAIL DATE	DELIVERY MODE
05/09/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/625,667	JORDAN ET AL.	
	Examiner	Art Unit	
	Mark A. Mais	2616	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-23* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-23* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *24 July 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *4/13/04; 1/11/05*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Information Disclosure Statement

1. The information disclosure statements (IDSs) were filed on April 13, 2004 and January 11, 2005. The submission is in compliance with the provisions of 37 C.F.R. 1.97. According, the examiner considered the IDSs.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1-23 are rejected under 35 U.S.C. 102(b) as being anticipated by Passint et al. (USP 6,101,181).

4. With regard to claim 1, Passint et al. discloses a cluster-based router **[multiprocessor system with a plurality of processing nodes, col. 3, lines 45-47]** comprising:

(a) a plurality of equivalent interconnected router cluster nodes, the routing capacity of the cluster router increasing substantially O(N) with the number N of router cluster nodes in the cluster router **[multiprocessor system with a plurality of processing nodes, col. 3, lines 45-47]**;

(b) a plurality of cluster router internal links interconnecting router cluster nodes forming an intra-connection network ensuring a high path diversity in providing resiliency to failures **[an acrylic network is deadlock free, col. 2, lines 64 to col. 3, line 16]**;

(c) each router cluster node having a group of cluster router external links enabling packet exchange with a plurality of external communication network nodes **[each router has numerous input/output ports for receiving/sending messages, col. 3, lines 50-54]**; and

(d) each router cluster node operating in accordance with a provisioned router-cluster-node-centric configuration to effect distributed routing of the conveyed packets, the equivalency between the router cluster nodes providing a scalable cluster router **[torus networks are formed which are scaleable in all n dimensions, col. 1, line 66 to col. 2, line 15; Fig. 8 shows a 6D hypercube topology multiprocessor system, col. 8, lines 19-31]**.

5. With regard to claim 12, Passint et al. discloses a router cluster node of a plurality of router cluster nodes interconnected in a cluster router **[multiprocessor system with a plurality of processing nodes, col. 3, lines 45-47]**, the router cluster node comprising:

(a) a plurality of cluster router internal interconnecting links connected thereto, the internal interconnecting links enabling the exchange of packets with adjacent router cluster nodes in the cluster router **[each router has numerous input/output ports for receiving/sending messages, col. 3, lines 50-54]**;

(b) at least one cluster router external link connected thereto, the at least one external link enabling exchange of packets between external communications network nodes and the cluster router **[each router has numerous input/output ports for receiving/sending messages, col. 3, lines 50-54]**; and

(c) a router-cluster-node-centric configuration to effect distributed routing of the conveyed packets **[torus networks are formed which are scaleable in all n dimensions, col. 1, line 66 to col. 2, line 15; Fig. 8 shows a 6D hypercube topology multiprocessor system, col. 8, lines 19-31]**,

the equivalency between router cluster nodes in the cluster router providing a scalable router **[Fig. 8 shows a 6D hypercube topology multiprocessor system, col. 8, lines 19-31; each cluster is equivalent forming a symmetric scaleable cluster]**.

6. With regard to claim 18, Passint et al. discloses a router-cluster-node-centric configuration enabling the provision of a distributed packet routing response in a cluster router having a plurality of router cluster nodes **[multiprocessor system with a plurality of processing nodes, col. 3, lines 45-47]**, the configuration comprising:

(a) a plurality of routing functional blocks **[each router has numerous input/output ports for receiving/sending messages, col. 3, lines 50-54; torus networks are formed which**

are scaleable in all n dimensions, col. 1, line 66 to col. 2, line 15; Fig. 8 shows a 6D hypercube topology multiprocessor system, col. 8, lines 19-31]; and

(b) at least one cluster-node-centric packet processing flow, via the plurality of routing functional blocks, to effect routing of packets received at the cluster router employing one of

a single router cluster node and

a group of router cluster nodes **[Fig. 8 shows a 6D hypercube topology multiprocessor system, col. 8, lines 19-31]**.

7. With regard to claim 19, Passint et al. discloses that the router-cluster-node-centric configuration claimed in claim 18, further comprising:

(a) an entry-and-routing processing packet processing flow specification; (b) a transit packet processing flow specification; and (c) an exit packet processing packet processing flow specification **[the global routing table (external addressing) and the local routing tables (internal addressing) provide both processor and link functionality (operating status) reporting, col. 13, line 20 to col. 14, line 34; for example, fault avoidance is provided (col. 13, lines 38-40)]**,

the packet processing flow specifications enabling a received packet to undergo entry and routing processing at an entry router cluster node, optionally transit via at least one intermediary router cluster node, and undergo exit processing at an exit router cluster node **[each router has numerous input/output ports for receiving/sending messages, col. 3, lines 50-54; torus networks are formed which are scaleable in all n dimensions, col. 1, line 66 to col. 2, line 15; Fig. 8 shows a 6D hypercube topology multiprocessor system, col. 8, lines 19-31; Fig. 9**

shows a system where each cluster has six links to six neighboring nodes, col. 8, lines 52-58].

8. With regard to claims 2 and 13, Passint et al. discloses that the router-cluster-node-centric configuration further comprises routing functional blocks and specifies packet processing flows between the routing functional blocks effecting packet routing employing one of:

a single router cluster node, and

a sequence of router cluster nodes **[Fig. 8 shows a 6D hypercube topology multiprocessor system, col. 8, lines 19-31]**.

9. With regard to claims 3 and 14, Passint et al. discloses that each router cluster node comprises a personal computer platform providing flexibility and cost savings in the development, deployment, maintenance, and expandability of the cluster router **[a desktop computer system (interpreted as a personal computer), col. 8, lines 33-34]**.

10. With regard to claims 4 and 15, Passint et al. discloses that the intra-connection network further comprises an n dimensional toroidal topology , wherein 2*n internal links interconnect each router cluster node with 2*n adjacent neighboring router cluster nodes; the routing capacity of the cluster router being increased substantially linearly by adding an n-1 dimensional slice of router cluster nodes to the cluster router **[torus networks are formed which are scaleable in all n dimensions, col. 1, line 66 to col. 2, line 15; Fig. 8 shows a 6D hypercube topology multiprocessor system, col. 8, lines 19-31]**.

11. With regard to claim 5, Passint et al. discloses that the intra-connection network comprises a three dimensional toroidal topology, wherein six internal links interconnect each router cluster node with six adjacent neighboring router cluster nodes **[torus networks are formed which are scaleable in all n dimensions, col. 1, line 66 to col. 2, line 15; Fig. 9 shows a system where each cluster has six links to six neighboring nodes, col. 8, lines 52-58]**.

12. With regard to claim 6, Passint et al. discloses that the intra-connection network further comprises one of

unidirectional and

bi-directional internal interconnecting links **[bidirectional links, input/output ports for receiving/ sending messages, col. 3, lines 52-54]**.

13. With regard to claim 7, Passint et al. discloses that the a router cluster node designated as a management node, should a management node designated router cluster node fail, designating another router cluster node as a management node without making changes to the cluster router infrastructure **[with torus/hypercube topologies, multiple available paths allow the system to bypass broken processors or links, col. 19, line 50 to col. 20, line 13]**.

14. With regard to claims 8, 16, and 17, Passint et al. discloses that (a) at least one management node **[with torus/hypercube topologies, multiple available paths allow the system to bypass broken processors or links, col. 19, line 50 to col. 20, line 13; each router is interpreted as a**

management node when it is routing a message (claim 17); thus, it must route the message to the correct destination despite broken processors or links]; and

(b) a plurality of management links interconnecting the at least one management node with the plurality of router cluster nodes **[Fig. 9 shows a system where each cluster has six links to six neighboring nodes, col. 8, lines 52-58 (claim 16)]** and enabling one of

out-of-band configuration deployment to each router cluster node **[side-band signaling, col. 12, lines 12-22]**,

router cluster node initialization, and

reporting functionality **[the global routing table and the local routing tables provide both processor and link functionality (operating status) reporting, col. 13, line 20 to col. 14, line 34; for example, fault avoidance is provided (col. 13, lines 38-40)]**;

employing the plurality of management links reducing an in-band cluster router management overhead **[e.g., one processor decides which direction to take by attaching the new route to the packet header used on the next router (and, thus, reducing overhead), col. 14, lines 30-34; moreover, the routing tables cannot be used for congestion control—further reducing overhead (col. 13, line 40)]**.

15. With regard to claim 9, Passint et al. discloses that the plurality of management links from one of a star **[star, mesh, ring, etc. col. 1, lines 433-45]** and

a bus topology .

16. With regard to claims 10, 20, and 21, Passint et al. discloses a cluster router internal addressing process dynamically determining router cluster node addressing **[the global routing table (external addressing) and the local routing tables (internal tag/addressing; especially for a series of same-tagged/addressed packets (claim 21)) provide both processor and link functionality (operating status) reporting, col. 13, line 20 to col. 14, line 34; for example, fault avoidance is provided (col. 13, lines 38-40)]**.

17. With regard to claim 11, Passint et al. discloses a cluster router external addressing process dynamically determining a cluster router address **[the global routing table (external addressing) and the local routing tables (internal addressing) provide both processor and link functionality (operating status) reporting, col. 13, line 20 to col. 14, line 34; for example, fault avoidance is provided (col. 13, lines 38-40)]**.

18. With regard to claim 22, Passint et al. discloses that each tag comprises a combination of:

an optional packet header **[sideband signaling, col. 12, lines 12-22]**,

a packet trailer **[tail micropackets, col. 12, lines 5-8]**, and

an additional header encapsulating the associated packet having cluster router relevance only **[the router tries to match the global ID first to look up in the global table; if unsuccessful, it looks to the local router table (interpreted as encapsulated within one another), col. 15, lines 41-55]**.

19. With regard to claim 23, Passint et al. discloses that each tag holds a tag time-to-live specification decremented while the associated packet propagates via router cluster nodes in the cluster, the packet being discarded when the time-to-live specification is zero and the packet has not reached a corresponding exit router cluster node thereby reducing transport overheads **[once the aging limit is reached (i.e., the message will be deleted), col. 12, lines 23-32]**.

Conclusion

20. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

(a) Passint et al. (USP 5,970,232), Router table lookup mechanism.

(b) Bestvaros et al. (USP 6,370,584), Distributed routing.

(c) Antonov (USP 6,044,080), Scaleable parallel packet router.

(d) Deneroff et al. (USP 6,973,559), Scaleable hypercube multiprocessor network for massive parallel processing.

(e) Bommareddy et al. (USP 6,779,039), System and method for routing message traffic suing a cluster of routers sharing a single logical IP address distinct from unique IP addresses of the routers.

(f) Lee et al. (USP 5,224,100), Routing technique for a hierarchical interprocessor-communication network between massively-parallel processors.

21. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mark A. Mais whose telephone number is 572-272-3138. The examiner can normally be reached on M-Th 5am-4pm.

22. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Seema Rao can be reached on 571-272-3174. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

23. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

MAM
April 18, 2007

Seema S. Rao 4130107
SEEMA S. RAO
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2600

SHEET 1 OF 1

FORM PTO-1449 (MODIFIED) U.S. Department of Commerce Patent and Trademark Office	ATTY. DOCKET NO. 3437-Z	SERIAL NO. 10/625,667
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use several sheets if necessary)	APPLICANT John Lawrence Jordan et al	
	FILING DATE July 24, 2003	GROUP Art Unit 2116

OIPE APR 13 2004 JC54 PATENT & TRADEMARK OFFICE

U.S. PATENT DOCUMENTS

EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION	
							YES	NO

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

	1.	Guido Appenzeller & Matthew Holliman, **Can Google Route? Building a High-Speed Switch from Commodity Hardware**, Q2/2003, www.stanford.edu/class/ee384y/projects/presentations/5appenz.ppt (20 pages)
	2.	**The Click Modular Router Project**, www.pdos.lcs.mit.edu/click/, pages 1-3,
	3.	Benjie Chen & Robert Morris, **Flexible Control of Parallelism in a Multiprocessor PC Router**, Laboratory for Computer Science, Massachusetts Institute of Technology, Cambridge, MA 02139, published in the Proceedings of the USENIX 2001 Annual Technical Conference, June 2001 (pages 1-14).
	4.	Eddie Kohler et al, **The Click Modular Router**, Laboratory for Computer Science, MIT (pages 1-33) (An article describing a previous version of this system was published in *Operating Systems Review 34(5) (Proceedings of the 17th Symposium on Operating Systems Principles)*, (pp 217-231, December 1999).
	5.	Eddie Kohler, **The Click Modular Router**, submitted to Department of Electrical Engineering and Computer Science, MIT, 2000 (pages 127).
	6.	**CBR Implementation**, www.cs.duke.edu/~marty/cbr/node2.html, pages 1-4.

EXAMINER	DATE CONSIDERED 4-18-2007

EXAMINER: Initial if citation is considered, draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

FORM PTO-1449 (MODIFIED) U.S. Department of Commerce Patent and Trademark Office

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use several sheets if necessary)

ATTY. DOCKET NO.	APPLICATION NO.
3437-Z	10/625,667
APPLICANT: John Lawrence Jordan et al	
FILING DATE: July 24, 2003	ART UNIT: 2661

U.S. PATENT DOCUMENTS

EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
		US 2003/0067925 A1	04/2003	Choe et al	370	400	
		US 2002/0147841 A1	10/2002	Lee	709	241	
		US 2003/0058850 A1	03/2003	Rangarajan et al	370	389	

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION YES	TRANSLATION NO

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

		TORE ANDERS AAMODT: "Design and Implementation Issues for an SCI Cluster Configuration System", SCI EUROPE, 28 September 1998 (1998-09-28), pages 1-7, XP002303112 Bordeaux, the whole document.
		KOHLER E. ET AL: "The Click Modular Router", ACM TRANSACTIONS ON COMPUTER SYSTEMS, ASSOCIATION FOR COMPUTING MACHINERY. NEW YORK, US, Vol. 18, No. 3, 2000, pages 263-296 XP002208133, ISSN: 0734-2071, the whole document.
		PRADHAN P. ET AL: "Implementation and Evaluation of A QoS - Capable Cluster-Based IP Router", IEEE, 16 November 2002 (2002-11-16), pages 1-13, XP002303130, the whole document.

EXAMINER _____ DATE CONSIDERED 4-18-2007

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Notice of References Cited	Application/Control No. 10/625,667	Applicant(s)/Patent Under Reexamination JORDAN ET AL.	
	Examiner Mark A. Mais	Art Unit 2616	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-6,101,181	08-2000	Passint et al.	370/352
*	B	US-5,224,100	06-1993	Lee et al.	370/408
*	C	US-6,779,039	08-2004	Bommareddy et al.	709/238
*	D	US-6,973,559	12-2005	Deneroff et al.	712/12
*	E	US-5,970,232	10-1999	Passint et al.	709/238
*	F	US-6,044,080	03-2000	Antonov, Vadim	370/401
*	G	US-6,370,584	04-2002	Bestavros et al.	709/238
	H	US-			
	I	US-			
	J	US-			
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FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
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NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
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	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims

Application/Control No.	Applicant(s)/Patent under Reexamination
10/625,667	JORDAN ET AL.
Examiner	**Art Unit**
Mark A. Mais	2616

√	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

Claim		Date								
Final	Original	4/18/07								
	1	√								
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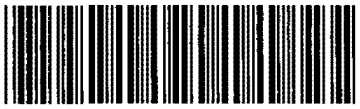
Search Notes



Application/Control No.	Applicant(s)/Patent under Reexamination	
10/625,667	JORDAN ET AL.	
Examiner	**Art Unit**	
Mark A. Mais	2616	

SEARCHED			
Class	Subclass	Date	Examiner
370	235-238 238.1	4/18/2007	MAM
	389 390		
	392 395.1		
	396 395.21		
	395.31 411		
	432 431		
	474 475 476		

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR
See Inventorship Search	4/18/2007	MAM
See Attached Electronic Search	4/18/2007	MAM

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Bib Data Sheet

CONFIRMATION NO. 8923

SERIAL NUMBER	FILING OR 371(c) DATE / RULE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
10/625,667	07/24/2003	370	2616	3437-Z

APPLICANTS

John Lawrence Jordan, Ottawa, CANADA;
Peter Rabinovitch, Kanata, CANADA;

** CONTINUING DATA **********

N/A

** FOREIGN APPLICATIONS **********

N/A

IF REQUIRED, FOREIGN FILING LICENSE GRANTED **
03/24/2004

Foreign Priority claimed	35 USC 119 (a-d) conditions met	Verified and Acknowledged	STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
☐ yes ☑ no	☐ yes ☒ no ☐ Met after Allowance	Examiner's Signature / Initials	CANADA	7	23	3

ADDRESS

Law Office of Jim Zegeer
Suite 108
801 North Pitt Street
Alexandria, VA22314

TITLE

Software configurable cluster-based router using stock personal computers as cluster nodes

FILING FEE RECEIVED	FEES: Authority has been given in Paper	
804	No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	2	(("6526055") or ("6965615")).PN.	USPAT; USOCR	OR	OFF	2007/04/30 03:15
L2	6199	("725").CLAS.	USPAT; USOCR	OR	OFF	2007/04/30 03:15
L3	3	(US-6778490-$ or US-6751191-$ or US-5923643-$).did.	USPAT	OR	ON	2007/04/30 03:15
L4	8753	((370/235) or (370/236) or (370/237) or (370/238) or (370/389) or (370/390) or (370/392) or (370/395.1) or (370/396) or (370/395.21) or (370/395.31) or (370/411) or (370/431) or (370/432) or (370/474) or (370/475) or (370/476)).CCLS.	USPAT; USOCR	OR	OFF	2007/04/30 03:15
L5	296	(370/476).CCLS.	USPAT; USOCR	OR	OFF	2007/04/30 03:15
L6	355	(370/475).CCLS.	USPAT; USOCR	OR	OFF	2007/04/30 03:15
L7	1146	(370/474).CCLS.	USPAT; USOCR	OR	OFF	2007/04/30 03:15
L8	418	(370/432).CCLS.	USPAT; USOCR	OR	OFF	2007/04/30 03:15
L9	296	(370/431).CCLS.	USPAT; USOCR	OR	OFF	2007/04/30 03:15
L10	136	(370/411).CCLS.	USPAT; USOCR	OR	OFF	2007/04/30 03:15
L11	201	(370/395.31).CCLS.	USPAT; USOCR	OR	OFF	2007/04/30 03:15
L12	335	(370/395.21).CCLS.	USPAT; USOCR	OR	OFF	2007/04/30 03:15
L13	291	(370/396).CCLS.	USPAT; USOCR	OR	OFF	2007/04/30 03:15
L14	780	(370/395.1).CCLS.	USPAT; USOCR	OR	OFF	2007/04/30 03:15
L15	1500	(370/392).CCLS.	USPAT; USOCR	OR	OFF	2007/04/30 03:15
L16	578	(370/390).CCLS.	USPAT; USOCR	OR	OFF	2007/04/30 03:15
L17	1902	(370/389).CCLS.	USPAT; USOCR	OR	OFF	2007/04/30 03:15
L18	441	(370/238).CCLS.	USPAT; USOCR	OR	OFF	2007/04/30 03:15

EAST Search History

L19	177	(370/237).CCLS.	USPAT; USOCR	OR	OFF	2007/04/30 03:15
L20	575	(370/236).CCLS.	USPAT; USOCR	OR	OFF	2007/04/30 03:15
L21	1237	(370/235).CCLS.	USPAT; USOCR	OR	OFF	2007/04/30 03:15
L22	3	(("6101192") or ("6965615") or ("6526055")).PN.	USPAT; USOCR	OR	OFF	2007/04/30 03:15
L23	2	(("6101192") or ("6965615")).PN.	USPAT; USOCR	OR	OFF	2007/04/30 03:15
L24	11	((switch$3) adj (engine$1)) SAME ((router) or (switch)) SAME (redundan$2)	US-PGPUB; USPAT	OR	ON	2007/04/30 03:15
L25	2344	((switch$3) adj (engine$1)) SAME ((router) or (switch))	US-PGPUB; USPAT	OR	ON	2007/04/30 03:15
L26	41	((switch$3) adj (engine$1)) SAME (router)	US-PGPUB; USPAT	OR	ON	2007/04/30 03:15
L27	33	((switching) adj (engine$1)) SAME (router)	US-PGPUB; USPAT	OR	ON	2007/04/30 03:15
L28	33	((switching) adj (engine)) SAME (router)	US-PGPUB; USPAT	OR	ON	2007/04/30 03:15
L29	738	((switching) adj (engine))	US-PGPUB; USPAT	OR	ON	2007/04/30 03:15
L30	0	((rotating) adj (symmetric) adj (topology))	US-PGPUB; USPAT	OR	ON	2007/04/30 03:15
L31	0	((rotational) adj (symmetric) adj (topology))	US-PGPUB; USPAT	OR	ON	2007/04/30 03:15
L32	0	((rotational) adj (symmetric) adj (topology))	USPAT	OR	ON	2007/04/30 03:15
L33	258	((JOHN) near2 (JORDAN)).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2007/04/30 03:38
L34	9	((PETER) near2 (RABINOVITCH)).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2007/04/30 03:53
L35	0	("2005/0018665").URPN.	USPAT	OR	ON	2007/04/30 03:56
L36	0	("2005/0108425").URPN.	USPAT	OR	ON	2007/04/30 03:57
L37	19	((cluster) near3 (router)) SAME (((personal) adj (computer)) or (PC) or (computer))	USPAT	OR	ON	2007/04/30 04:14
L38	1	((cluster) near3 (router)) AND (((personal) adj (computer)) or (PC) or (computer)) AND (toroid$3)	USPAT	OR	ON	2007/04/30 05:12
L39	1	((cluster) near3 (router)) AND (toroid$3)	USPAT	OR	ON	2007/04/30 05:12

EAST Search History

L40	1	((cluster) near3 (router$1)) AND (toroid$3)	USPAT	OR	ON	2007/04/30 05:13
L41	133	(router$1) AND (toroid$3)	USPAT	OR	ON	2007/04/30 05:14
L42	0	(router$1) AND ((2n$1) adj (toroid$3))	USPAT	OR	ON	2007/04/30 05:14
L43	21	(router$1) SAME (toroid$3)	USPAT	OR	ON	2007/04/30 05:15
L44	112	L41 not L43	USPAT	OR	ON	2007/04/30 05:15

Atty. Docket No.: 3437-Z

IFW

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of
John Lawrence Jordan et al
Application No. 10/625,667
Filed: July 24, 2003
For: Software Configurable Cluster-Based Router Using Stock Personal Computers as Cluster Nodes

Art Unit 2661

INFORMATION DISCLOSURE STATEMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This Information Disclosure Statement is submitted:

[X] under 37 CFR 1.97(b), or
(Within three months of filing national application; or date of entry of international application; or before mailing date of first Office action on the merits; whichever occurs last.)

[] under 37 CFR 1.97(c) together with either a:
[] Certification under 37 CFR 1.97(e), or
[] a $180.00 fee under 37 CFR 1.17(p), or
(After the CFR 1.97(b) time period, but before final action or notice of allowance, whichever occurs first.)

[] under 37 CFR 1.97(d) together with either a:
[] Certification under 37 CFR 1.97(e), and
[] a petition under 37 CFR 1.97(d)(2)(ii), and
[] a $130.00 petition fee set forth in 37 CFR §117(i)(1).
(Filed after final action or notice of allowance, whichever occurs first, but before payment of the issue fee.)

Applicant(s) submits herewith Form PTO 1449-Information Disclosure Citation together with copies of patents, publications or other information of which applicant(s) is aware, which applicant(s) believe(s) may be material to the examination of this application and for which there may be a duty to disclose in accordance with 37 CFR 1.56. [XX] These references were cited in an International Search Report completed 3 November 2004, a copy of which is attached.

The relevance of the attached references is that this is the closest art of which applicant(s) is aware.

Applicant(s) submits that the above references taken alone or in combination neither anticipate nor render obvious the present invention. Consideration of the foregoing in relation to this application is respectfully requested.

Respectfully submitted,

Jim Zegeer

Jim Zegeer, Reg. No. 18,957
Attorney for Applicant(s)

Attachments:
Form PTO-1449 and cited references

Suite 108
801 North Pitt Street
Alexandria, VA 22314
Telephone: 703-684-8333
Date: January 10, 2005

In the event this paper is deemed not timely filed, the applicant hereby petitions for an appropriate extension of time. The fee for this extension may be charged to Deposit Account No. 26-0090 along with any other additional fees which may be required with respect to this paper.

SHEET 1 OF 1

FORM PTO-1449 (MODIFIED) U.S. Department of Commerce Patent and Trademark Office	ATTY. DOCKET NO. 3437-Z	APPLICATION NO. 10/625,667
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use several sheets if necessary)	APPLICANT John Lawrence Jordan et al	
	FILING DATE July 24, 2003	ART UNIT 2661

U.S. PATENT DOCUMENTS

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		US 2003/0067925 A1	04/2003	Choe et al	370	400	
		US 2002/0147841 A1	10/2002	Lee	709	241	
		US 2003/0058850 A1	03/2003	Rangarajan et al	370	389	

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		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION	
							YES	NO

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		KOHLER E. ET AL: "The Click Modular Router", ACM TRANSACTIONS ON COMPUTER SYSTEMS, ASSOCIATION FOR COMPUTING MACHINERY. NEW YORK, US, Vol. 18, No. 3, 2000, pages 263-296 XP002208133, ISSN: 0734-2071, the whole document.
		PRADHAN P. ET AL: "Implementation and Evaluation of A QoS - Capable Cluster-Based IP Router", IEEE, 16 November 2002 (2002-11-16), pages 1-13, XP002303130, the whole document.

EXAMINER	DATE CONSIDERED

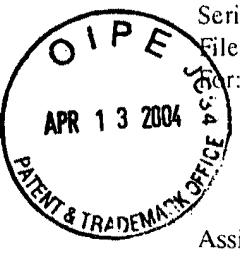
EXAMINER: Initial if citation is considered, draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Atty. Docket No. 3437-Z

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of
John Lawrence Jordan et al
Serial No. 10/625,667
Filed: July 24, 2003
For: **Software Configurable Cluster-Based Router Using Stock Personal Computers as Cluster Nodes**

Group Art Unit 2661



INFORMATION DISCLOSURE STATEMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

This Information Disclosure Statement is submitted:

[X] under 37 CFR 1.97(b), or
(Within three months of filing national application; or date of entry of international application; or before mailing date of first Office action on the merits; whichever occurs last.)

[] under 37 CFR 1.97(c) together with either a:
- [] Certification under 37 CFR 1.97(e), or
- [] a $180.00 fee under 37 CFR 1.17(p), or

(After the CFR 1.97(b) time period, but before final action or notice of allowance, whichever occurs first.)

[] under 37 CFR 1.97(d) together with either a:
- [] Certification under 37 CFR 1.97(e), and
- [] a petition under 37 CFR 1.97(d)(2)(ii), and
- [] a $130.00 petition fee set forth in 37 CFR §117(i)(1).

(Filed after final action or notice of allowance, whichever occurs first, but before payment of the issue fee.)

Applicant(s) submits herewith Form PTO 1449-Information Disclosure Citation together with copies of patents, publications or other information of which applicant(s) is aware, which applicant(s) believe(s) may be material to the examination of this application and for which there may be a duty to disclose in accordance with 37 CFR 1.56.

The relevance of the attached references is that this is the closest art of which applicant(s) is aware.

Applicant(s) submits that the above references taken alone or in combination neither anticipate nor render obvious the present invention. Consideration of the foregoing in relation to this application is respectfully requested.

Respectfully submitted,

Jim Zegeer

Jim Zegeer, Reg. No. 18,957
Attorney for Applicant(s)

Attachments:
Form PTO-1449 and cited references

Suite 108
801 North Pitt Street
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Telephone: 703-684-8333
Date: April 13, 2004

In the event this paper is deemed not timely filed, the applicant hereby petitions for an appropriate extension of time. The fee for this extension may be charged to Deposit Account No. 26-0090 along with any other additional fees which may be required with respect to this paper.

FORM PTO-1449 (MODIFIED) U.S. Department of Commerce Patent and Trademark Office

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use several sheets if necessary)

ATTY. DOCKET NO.	SERIAL NO.
3437-Z	10/625,667
APPLICANT: John Lawrence Jordan et al	
FILING DATE: July 24, 2003	GROUP: Art Unit 2116

U.S. PATENT DOCUMENTS

EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION	
							YES	NO

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

	1.	Guido Appenzeller & Matthew Holliman, **Can Google Route? Building a High-Speed Switch from Commodity Hardware**, Q2/2003, www.stanford.edu/class/ee384y/projects/presentations/5appenz.ppt (20 pages)
	2.	**The Click Modular Router Project**, www.pdos.lcs.mit.edu/click/, pages 1-3,
	3.	Benjie Chen & Robert Morris, **Flexible Control of Parallelism in a Multiprocessor PC Router**, Laboratory for Computer Science, Massachusetts Institute of Technology, Cambridge, MA 02139, published in the Proceedings of the USENIX 2001 Annual Technical Conference, June 2001 (pages 1-14).
	4.	Eddie Kohler et al, **The Click Modular Router**, Laboratory for Computer Science, MIT (pages 1-33) (An article describing a previous version of this system was published in *Operating Systems Review 34(5) (Proceedings of the 17th Symposium on Operating Systems Principles)*, (pp 217-231, December 1999).
	5.	Eddie Kohler, **The Click Modular Router**, submitted to Department of Electrical Engineering and Computer Science, MIT, 2000 (pages 127).
	6.	**CBR Implementation**, www.cs.duke.edu/~marty/cbr/node2.html, pages 1-4.

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Atty. Docket No.: 3437-Z

UTILITY PATENT APPLICATION TRANSMITTAL
(Only for new nonprovisional applications under 37 C.F.R. §1.53(b))

Box PATENT APPLICATION
Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Transmitted herewith for filing is the patent application of:

INVENTOR(S): 1. John Lawrence Jordan
2. Peter Rabinovitch

TITLE: **Software Configurable Cluster-Based Router Using Stock Personal Computers as Cluster Nodes**

1. [X] Specification of 27 pages.
   [X] Claims, 23 in number.
   [X] Abstract.
2. [X] Drawings. Total Sheets: 7
3. [X] Oath or Declaration.
   a. [X] Newly executed (original or copy)
   b. [] Copy from prior application (37 CFR 1.63(d))
   (for continuation/divisional with Box 5 completed)

   i. [] DELETION OF INVENTOR(S)
   Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
4. [] Application Data Sheet. See 37 CFR 1.76.

5a. [] **If a CONTINUING APPLICATION**, check appropriate box and supply the requisite information below and in a preliminary amendment, or in an Application Data Sheet under 37 CFR 1.76:

[] Continuation [] Divisional [] Continuation-in-part (CIP):
of prior application Serial No.: _____
Prior application information: Group Art Unit: Examiner:

For: CONTINUATION OR DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 3b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application part.

5b. [] The present application is a nonprovisional application based on Provisional Application Serial No. _____ filed _____.

6. [] Applicant claims small entity status. (see 37 CFR 1.27)

7. [X] An assignment of the invention to: Alcatel and Recordation Form Cover Sheet with fee authorization.

8. [] Applicant claims the priority of corresponding application No. _____ filed _____.

9. [] Preliminary Amendment

10. [] Information Disclosure Statement (IDS) PTO-1449
[] Copies of IDS Citations.

11. [X] Return Receipt Postcard (MPEP 503)

12. [] Other:

13. [X] The filing fee has been calculated as shown below:

For	No. Filed	Basic	No. Extra	Rate $	Calculations
Total Claims	23	20	3	$ 18.00	$ 54.00
Indep. Claims	3	3	0	$ 84.00	$ .00
[ ] Multiple Dependent Claims				$280.00	$
BASIC FEE					$750.00
TOTAL OF ABOVE CALCULATIONS					$804.00
[] Reduction by 1/2 For Filing By Small Entity					$
TOTAL FILING FEE					$804.00
[X] Fee For Recording of Assignment ($40.00)					$ 40.00
TOTAL OF FILING AND ASSIGNMENT RECORDING FEES					$844.00

14. [X] A check in the amount of $ 804.00 to cover the Filing Fee is enclosed. If no check is enclosed and a fee is due in connection with this communication or if the check enclosed is insufficient, the Commissioner is authorized to charge any fee or additional fee due (or credit any overpayment) in connection with this communication, or at any time during the pendency of this application, to Deposit Account No. 26-0090.

15. [X] Correspondence Address:

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16. [X] Associate Power of Attorney to Jim Zegeer.

Respectfully submitted,

Jim Zegeer

Jim Zegeer, Reg. No. 18,957
Attorney for Applicants

Date: July 24, 2003

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Atty. Docket No.: 3437-Z

UTILITY PATENT APPLICATION TRANSMITTAL
(Only for new nonprovisional applications under 37 C.F.R. §1.53(b))

Box PATENT APPLICATION
Assistant Commissioner for Patents
Washington, D.C. 20231

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2. Peter Rabinovitch

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of prior application Serial No.: _____
Prior application information: Group Art Unit: Examiner:

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Respectfully submitted,

Jim Zegeer

Jim Zegeer, Reg. No. 18,957
Attorney for Applicants

Date: July 24, 2003

Software Configurable Cluster-Based Router using Stock Personal Computers as Cluster Nodes

Field of the invention

[01] The invention relates to routing packets in packet-switched communication networks, and in particular to methods and apparatus for distributed routing response determination.

Background of the invention

[02] In the field of packet-switched communications, transported content is conveyed between source and destination communications network nodes in accordance with a store-and-forward discipline. The content to be transported is segmented, and each content segment is encapsulated in a packet by adding headers and trailers. Each packet is transmitted by the source network node into an associated communications network over communication links interconnecting communications network nodes. At each node, a packet is received, stored (buffered) while awaiting a packet processing response, and later forwarded over a subsequent interconnecting link towards the intended destination network node in accordance with: a destination node specification held in the packet header, and forwarding specifications provided via the packet processing response.

[03] Packet processing responses include, but are not limited to: switching, routing, traffic classification, traffic/content filtering, traffic shaping, content/traffic encapsulation, content encryption/decryption, etc. responses. A switching response in the context of a network node processing a particular received packet, specifies that the packet is to be forwarded via a particular output port of the network node. A routing response relates to a switching response determined based on a group of routing criteria. The routing criteria

may include, but are not limited to: communication link states, service level specifications, traffic classification, source/destination network node specification, time-of-day, congestion conditions, etc.

[04] One of the benefits of the store-and-forward discipline employed in conveying packets in packet-switched communication networks, stems from an ability of packet-switched networks to route packets around failed/congested communications network infrastructure, diminishing an otherwise need for a redundant communication network infrastructure, to reliably transport packets between source and destination network nodes.

[05] One of the drawbacks of the store-and-forward discipline employed in conveying packets in packet-switched communication networks, stems from delays incurred in obtaining packet processing responses – probably the most notable being the routing response delay which is for the most part non-deterministic.

[06] Single unit, dedicated, hardware implemented router communication network nodes have been developed and deployed with various levels of success. Single unit, packet-switching communications network nodes implementing virtual routers have also been developed and deployed with various levels of success. However content transport capacity over interconnecting links, known as transport bandwidth, continues to increase at exponential rates, as well component miniaturization has enabled the aggregation of large amounts of packet traffic into such dedicated single unit router nodes. A lot of research and development has and is being undertaken in respect of packet router network node design, which has lead to special purpose solutions typically addressing specific packet processing issues and/or to support specific services via dedicated (units) equipment. Router development costs are incurred in designing and validating the routing functionality, as well in designing and validating the special purpose, dedicated, router node hardware.

[07] The single unit, dedicated, hardware implemented routers have evolved from computer-host-type network nodes. The relatively large expense associated with the development and deployment of single unit, special purpose, dedicated, hardware implemented routers has caused researchers to reconsider computer-host-type router implementations as personal computer equipment costs have decreased relative to the computing capability provided. The intent is to leverage readily available personal-computer hardware, which has also undergone separate intense development and standardization, to provide routing functionality comparable to hardware implemented router nodes. Returning to computer-host-type router solutions is in some ways considered a step back, because computer-host router implementations are software-based router implementations lacking packet processing response time guarantees, whereas dedicated router (equipment) nodes tend to implement the routing functionality in hardware which provides bound packet processing response times.

[08] FIG. 1 is a generic functional block diagram showing a legacy Personal Computer (PC) software-based router implementation. The legacy PC router implementation 100, which runs an operating system platform 102 such as, but not limited to, Linux, includes software-implemented routing functionality, such as, but not limited to: packet filtering 110, packet header modification 112, packet queuing 114, scheduling 116 etc. The routing behavior of the legacy PC router 100 can be re-configured by re-coding the desired router functionality (110 – 116). Typically legacy PC router implementations 100 execute optimized special-purpose code to effect routing. While special-purpose code provides some efficiencies in providing routing responses, such solutions are not necessarily optimal under all conditions and typically lead to proprietary implementations addressing particular service deployments. Over-optimization leads to inflexible and expensive to maintain solutions.

[09] Improvements towards an improved PC-based router implementation includes the configurable Click router framework project at the Massachusetts

Institute of Technology, U.S.A., a description of which can be found at http://www.pdocs.lcs.mit.edu/click/. Various developers have contributed to the development of the Click router framework including: Eddie Kohler (Ph.D. thesis student), Professor M. Frans Kaashoek and Professor Robert Morris, Benjie Chen, and John Jannotti.

[10] The Click router framework development started as an investigation into possible routing response processing improvements achievable by codifying discrete router functional blocks which, via a high level router description language, could be flexibly combined to implement (PC-based) router functionality at reduced router code maintenance overheads. FIG. 2 shows an exemplary prior art Click router configuration 200 implementing an exemplary Internet Protocol (IP) router, the configuration 200 specifying discrete router functional blocks and packet processing flows defined between the discrete router functional blocks.

[11] Various levels of success were attained, including the realization that, in order to achieve superior packet throughput through a single standard PC-based router, running a typical operating system, a closer coupling between the operating system, router software (Click in the MIT investigation), and the Network Interface Cards (NIC) (physical ports) was necessary. The typical interrupt handling technique ubiquitously used by network interface cards to report receiving a packet, and to announce availability to transmit a packet, was replaced by a polling technique to eliminate "receive livelock" conditions. It was found that using poling techniques, minimum-sized packet throughput increased fourfold. Minimum-sized packets are the most demanding of all types of packets when it comes to providing a processing response, as PC central processor resources are consumed in proportion to the number of packets processed not in proportion to the content bandwidth conveyed. The bandwidth conveyed is ultimately limited by the bandwidth of the PC bus. Statistically however, the median packet size is relatively small in a typical use environment.

[12] Other results of the MIT Click investigation, include the definition of only sixteen generic discrete functional router blocks as a framework for implementing comprehensive packet processing responses – other specific functional router blocks being derived from the sixteen generic functional router blocks. In providing packet processing responses, the prior art typically concentrates on queuing disciplines and queue service disciplines. In the prior art, each routing function (filter 110, process 112, queue 114, schedule 116) contended for CPU time and cache. The Click investigation, however, looked into potential improvements achievable by prioritizing packet processing flows within a single PC-based router, and found that improvements may be benefited from careful allocation of CPU processing resources to packet processing flows which reduced CPU cache misses.

[13] Further results of the MIT Click investigation, include the adaptation of the Click router framework software code to operate on a multi-processor-single-PC-based platform. The investigation continued toward prioritizing packet processing flows seeking benefits from careful allocation of the processing resources of all CPUs of the multiple-processor-PC platform to packet processing flows. CPU allocation to port-related packet processing flows seemed to provide best results by leveraging parallel processing over the multitude of processors (a maximum of 4 CPUs per PC-based router were employed in the investigation). However, it was found that one of the most detrimental of overheads were cache misses whose minimization correlated with increased packet processing throughput.

[14] However, the sharing of a single data bus between the multiple processors of the single-PC router implementation represented a limitation as, during periods of high packet throughput, the multiple CPUs contend for the single data bus. Therefore, implementing large capacity routers in accordance with the MIT Click investigation is difficult and/or very expensive to achieve because a very fast PC computing platform is required. This is due to the fact

that the Click routing framework design is based on employing a single PC platform, and hence its performance is limited by the speed of the PC platform.

[15] In the field of distributed computing there is a current push to achieve network computing. Recent developments include the Scalable Coherent Interface (SCI) initiative which focuses on using new high bandwidth and low latency memory-mapped networks to build high performance cluster computing servers. The work in progress includes SCIOS, published on the Internet at http://sci-serv.inrialpes.fr/SciOS/whatis_scios.html, (contributor: Mr. Emmanuel Cecchet, France), which is an operating system module for the Linux operating system kernel offering services for managing resources in a cluster of Linux network nodes interconnected in an SCI network. The work in progress also includes SCIFS, published on the Internet at http://sci-serv.inrialpes.fr/SciFS/whatis_scifs.html, which is a file system module for the Linux kernel offering services for implementing a distributed shared virtual memory, built on top of SCIOS, using a memory mapped file concept.

[16] The success of distributed computing towards achieving network computing, including the SCIOS/SCIFS initiative, hinges on the type of computation necessary to solve a problem. Network computing provides computation efficiencies, if the necessary work to solve the problem can be divided into discrete and independent work units, such that the processing of each work unit has a minimal to no influence on the processing of other work units. A successful such network computing implementation is the SETI@Home project where processing each work unit involves determining self correlation between recorded signals in a single work unit.

[17] Investigations into distributed routing must take into account the issues pointed out by the Click initiative, that of packet processing flows traversing multiple routing functional blocks. The single PC-platform-based Click router framework investigation does not address network computing implementation issues and it is difficult to envision how, on their own, the results of the Click

router framework investigation can be employed directly to provide distributed routing.

[18] A prior art attempt towards distributed routing was made by Martin Gilbert, Richard Kisley, Prachi Thakar of Duke University, U.S.A., published on the Internet at http://www.cs.duke.edu/~marty/cbr/, entitled "Scalable Routing Through Clusters". Gilbert et al. employed an experimental setup having two interconnected but otherwise independent PC-based routers.

[19] Further, Gilbert et al. found that, packets which cannot be received and sent from the same entry router node in the cluster router, must be forwarded from the entry router node over an intra-connection network to the exit router node, from where the packets are forwarded into an associated external communications network.

[20] Gilbert et al. realized that, for a cluster of PC-based routers to operate as a "single" router, it is was necessary for the Time-To-Live (TTL) packet header value to be decremented only once by exit nodes in the cluster. Gilbert et al. used a packet tagging technique and packet TTL decrement suppression code to prevent premature packet TTL decrements. The proposed solution actually introduced a problem: low TTL value packets are processed through the router cluster (in the Gilbert et al. implementation by both PC-based clusters) only to be dropped by exit cluster nodes, the corresponding Internet Control Message Protocol (ICMP) messages being sent from the exit router node and routed back through the router cluster (2 PC routers) towards the source. The proposed solution was extended to identify packets bearing low packet TTL values to be processed immediately, at entry nodes in the cluster, rather than processing these packets through the cluster.

[21] To implement the intra-connection network, Gilbert et al. found it necessary to employ an additional lightweight protocol and a hierarchical naming scheme for router nodes in the cluster. The proposed solution was not without problems, of which Gilbert et al. identified: a routing overhead

consisting of additional routing messages which needed to be exchanged in the cluster to propagate routing information related to external and internal changes to the cluster; extra protocol stack handling due to packets traversing several router nodes which involved examining each packet being processed at the IP layer to determine correct forwarding; and bandwidth reservation in the intra-connection network had to take into account the internal overhead. Although recognized as not ideal, Gilbert et al. propose employing statically-coded routing at each router node in the cluster to address the route-information sharing problem. Gilbert et al. state that "the ideal solution would be that the intra-connection network is completely transparent", and provide only a characterization stressing that: "[as the number of router nodes in the cluster increases], the latency associated with the extra protocol translation and physical link traversal on the intra-connection network will limit end-to-end throughput." Gilbert et al. call for employing, perhaps future faster packet transport technologies to alleviate these issues in order to achieve the stated goals of their presented solution.

[22] Yet another prior art investigation into distributed routing is presented in FIG. 3 which shows an architecture referred to as a cluster-based router (CbR). The 4x4 cluster-based router 300 shown is comprised of four 2x2 router modules 310. Each of the routing modules 310 is implemented on a PC computing platform having gigabit Ethernet (1 GE), or similar, high speed interfaces 320. The 2x2 router modules 310 are interconnected in a manner that forms a non-blocking 4x4 routing architecture. Different sizes and arrangements of router modules 310 are possible to form different sized router clusters 300. Furthermore, a hierarchy of cluster-based routers 300 can be used to form even larger cluster-based routers. For example, a 16x16 CbR could be created from four of the 4x4 cluster-based routers 300 shown in FIG. 3. General details of this prior art proposal used to be found on the Internet at http://www.stanford.edu/class/ee384y/, but the details are no longer published.

[23] The CbR router 300 lacks flexibility in configuring thereof to address specific routing issues, and changes in routing functionality require new hardware or new code development. Moreover, it is apparent that a scalability issue exists as the number of 2x2 router modules 310 increases as $O(N^2)$ for an O(N) growth in ports.

[24] Another prior art investigation into the feasibility of using a Clos network to implement distributed routing is entitled "Can Google Route?" and was presented by Guido Appenzeller and Mathew Holliman. The Clos network architecture is proposed because such a design is non-blocking.

[25] Appenzeller and Holliman show a dramatic increase in cost-per-gigabit with total throughput for single unit dedicated routers. Appenzeller and Holliman show that using Clos-network-type router clusters is only more economical than single unit dedicated hardware routers for implementations involving very large numbers of ports. In general Clos networks employ a hierarchy of nodes: edge and core. Edge nodes exchange packets with external communications networks while core nodes do not, which is why, in general, switching N inputs to N outputs requires $(N/4)\ \log_4 N\ (1.5)^{\log_2 \log_4 N}$ which increases $O((N/4)\ \log_4 N)$ with N.

[26] Further Appenzeller and Holliman confirm the results of the MIT Click investigation, in that the use of PC bus interrupt techniques represents a packet throughput bottleneck and propose aggregating short packets. To implement the proposal, the network interface cards employed must have large buffers operating at line speed which negatively impacts the cost of such an deployment. While the MIT Click investigation proposes to use optimized network interface card polling techniques, Appenzeller and Holliman propose a less optimum solution of using Linux in halted mode.

[27] In view of the aforementioned shortcomings of the prior art investigations, what is desired is a low-cost router that is flexible, and scalable in routing capacity and port count.

Summary of the invention

[28] In accordance with an aspect of the invention, a cluster-based router is provided. The cluster router includes a plurality of equivalent interconnected router cluster nodes, the routing capacity of the cluster router increasing substantially O(N) with the number N of router cluster nodes in the cluster router. A plurality of cluster router internal links interconnect router cluster nodes forming an intra-connection network ensuring a high path diversity in providing resiliency to failures. Each router cluster node has a group of cluster router external links enabling packet exchange with a plurality of external communication network nodes. And, each router cluster node operates in accordance with a provisioned router-cluster-node-centric configuration to effect distributed routing of the conveyed packets. The equivalency between the router cluster nodes providing a scalable cluster router.

[29] In accordance with another aspect of the invention, the intra-connection network further comprises an n dimensional toroidal topology. 2*n internal links interconnect each router cluster node with 2*n adjacent neighboring router cluster nodes; the routing capacity of the cluster router being increased substantially linearly by adding an n-1 dimensional slice of router cluster nodes to the cluster router.

[30] In accordance with a further aspect of the invention, the cluster router further includes: at least one management node; and a plurality of management links interconnecting the at least one management node with the plurality of router cluster nodes. The plurality of management links enable one of out-of-band: configuration deployment to each router cluster node, router cluster node initialization, and reporting functionality. Employing the plurality of management links, reduces an in-band cluster router management overhead.

[31] In accordance with a further aspect of the invention, the plurality of management links from a one of a star and bus topology.

[32] In accordance with a further aspect of the invention, the cluster router further includes an internal addressing process dynamically determining router cluster node addressing.

[33] In accordance with a further aspect of the invention, the cluster router further includes an external addressing process dynamically determining a router cluster address.

[34] In accordance with a further aspect of the invention, a router cluster node of a plurality of router cluster nodes interconnected in a cluster router is provided. The router cluster node includes a plurality of cluster router internal interconnecting links connected thereto, the internal interconnecting links enabling the exchange of packets with adjacent router cluster nodes in the cluster router. At least one cluster router external link connected thereto, the at least one external link enabling exchange of packets between external communications network nodes and the cluster router. And, a router-cluster-node-centric configuration to effect distributed routing of the conveyed packets. The equivalency between router cluster nodes in the cluster router providing a scalable router.

[35] In accordance with a further aspect of the invention, a router-cluster-node-centric configuration is provided. The router-cluster-node-centric configuration enables the provision of a distributed packet routing response in a cluster router having a plurality of router cluster nodes. The configuration specifies a plurality of routing functional blocks; and at least one cluster-node-centric packet processing flow, via the plurality of routing functional blocks. The routing of packets received at the cluster router is effected employing one of a single router cluster node and a group of router cluster nodes.

[36] In accordance with a further aspect of the invention, the router-cluster-node-centric configuration includes: an entry-and-routing processing packet processing flow specification; a transit packet processing flow specification; and an exit packet processing packet processing flow specification. The packet

processing flow specifications enable a received packet to undergo entry-and-routing processing at an entry router cluster node, optionally transit via at least one intermediary router cluster node, and undergo exit processing at an exit router cluster node.

[37] In accordance with a further aspect of the invention, the router-cluster-node-centric configuration employs a tag conveyed with each packet within the cluster router infrastructure. The tag holds specifiers tracking packet processing within the cluster router.

[38] In accordance with yet another aspect of the invention, each tag holds a tag time-to-live specification decremented while the associate packet propagates via router cluster nodes in the cluster. The packet is discarded when the time-to-live specification is zero and the packet has not reached a corresponding exit router cluster node thereby reducing transport overheads.

[39] Advantages are derived from: a configurable, and scalable cluster router design providing a high routing capacity using cost effective stock PC hardware; from the toroidal topology of the intra-connection network which provides a high degree of diversity ensuring resilience to equipment failure, and from the use of the star topology of the management links which reduces management overheads in the intra-connection network.

Brief description of the drawings

[40] The features and advantages of the invention will become more apparent from the following detailed description of the preferred embodiments with reference to the attached diagrams wherein:

FIG. 1 is a schematic diagram showing elements implementing a prior art personal computer executing packet routing software code;

FIG. 2 is a schematic diagram showing packet processing flows directing packets between router functional blocks in accordance with a Click configuration implementing an exemplary IP router;

FIG. 3 is a schematic diagram showing a prior art non-blocking cluster-based router architecture;

FIG. 4 is a schematic diagram showing, in accordance with an exemplary embodiment of the invention, a cluster-based router architecture;

FIG. 5 A, B and C are schematic flow diagrams showing exemplary packet processing flows and routing functional blocks providing packet routing in accordance with an exemplary embodiment of the invention; and

FIG. 6 is another schematic flow diagram showing exemplary packet processing flows and routing functional blocks providing packet routing in accordance with the exemplary embodiment of the invention.

[41] It will be noted that in the attached diagrams like features bear similar labels.

Detailed description of the embodiments

[42] In accordance with an exemplary embodiment of the invention, FIG. 4 shows an exemplary cluster-based router implementation 400 which includes a 3 x 4 x 3 arrangement (cluster) of PC router cluster nodes 402 interconnected in accordance with a toroidal topology. The invention is not limited to the number of PCs or to the topology shown. An arbitrary number of router cluster nodes 402 (typically a large number) may be interconnected in accordance with various topologies without limiting the invention. The choice of the number of router cluster nodes 402 is chosen to obtain a required routing capacity, while the chosen topology employed is a balance between advantages and

disadvantages including, but not limited to: cost, complexity, delay, blocking probability, etc. which may be dependent on the routing capacity.

[43] In accordance with the exemplary embodiment shown, the individual router cluster nodes 402 are arranged in x, y, and z slices, and each router cluster node 402 is physically connected 404 to adjacent router cluster nodes 402 in the x, y, and z directions. In is pointed out that only two z-toroidal inter-connections are shown in order to improve clarity of FIG. 4, however every router cluster node 402 participates in a z-toroid of which there are twelve in total. The toroidal interconnections 404 shown, implement a dedicated cluster intra-connection network. In order to simplify the presentation of the relevant concepts, interconnections 404 will be referred to herein as internal interconnection links 404 (connected to internal ports) without limiting the invention thereto. Each internal interconnecting link 404 between any two router cluster nodes 402 may either be a unidirectional or a bi-directional link without limiting the invention.

[44] Wraparound internal interconnection links 404 complete toroidal interconnectivity ensuring that every router cluster node 402 has, in accordance with the exemplary toroidal topology employed, six adjacent router cluster nodes 402 to provide path diversity. Should any router cluster node 402 or internal interconnecting link 404 fail, the toroidal topology ensures that other paths between any source and destination router cluster nodes 402 exist.

[45] In accordance with the exemplary toroidal topology of the exemplary embodiment of the invention, should a number of the router cluster nodes 402 or interconnecting links 404 fail, the cluster router 400 will continue to route packets, perhaps, but not necessarily, at a reduced routing capacity until the failed infrastructure is brought back on-line. Whether packet routing capacity is affected by a particular infrastructure failure, is dependent on the actual packet traffic patterns within the cluster router 400. However, as long as routing capacity and packet transport capacity is still available in the cluster router 400,

the toroidal interconnectivity provides the possibility for work distribution over the remaining router cluster nodes 402.

[46] The toroidal topology employed can be extended to multiple dimensions: rather than linking each router cluster node 402 only to neighbor router cluster nodes 402 in the x, y and z direction, each router cluster node 402 can be linked to 2*n neighbors in n dimensions. The additional interconnectivity provides: increased path diversity thereby reducing blocking probability, reductions in the number of hops between entry and exit router cluster node 402 pairs, reductions in transmission delay, and provides the possibility for work distribution away from congested router cluster nodes 402 (congestion mitigation). Theses advantages come at a cost of increased wiring, maintenance, work distribution decision making, etc. complexity; and an increased cost of: a large number of cables, a correspondingly large number of network interface cards, PC motherboards adapted to interconnect with numerous network interface cards, multiported network interface cards, etc. Thus the choice of a specific interconnection density is an design choice to be made based on specific application environment requirements.

[47] In accordance with the exemplary embodiment of the invention, employing toroidal interconnectivity between the router cluster nodes 402 enables all router cluster nodes 402 to be equivalent. In particular the toroidal topology does not dictate which router cluster nodes 402 are edge or core router cluster nodes 402. Such designations may of course be made logically, if necessary, and may only apply to a specific service being provisioned. However depending on each particular implementation, such designations may bring about a management overhead. The equivalency between router cluster nodes 402 enables each router cluster node 402 to have external physical links (schematically shown as patch bays) providing physical connectivity to communications network(s) in which the cluster router 400 participates. Therefore, in accordance with the exemplary embodiment of the invention, each

router cluster node 402 may act as an entry, core, and/or exit router cluster node 402 relative to the packet traffic processed by the cluster router 400.

[48] The router cluster node equivalency, provided via the toroidal topology, provides a highly scalable packet routing capacity and port count increasing monotonically ~O(N) with the number N of router cluster nodes 402 in the cluster router 400. Additional capacity may be added typically by adding another x, y, or z slice (n-1 dimensional plane) of router cluster nodes 402 without requiring replacement or expansion of the existing infrastructure.

[49] The cluster router 400 may be controlled by management software allowing an operator to configure the behavior of each router cluster node 402 and therefore of the entire cluster router 400 via a software-based specification language with appropriately coded routing functionality blocks (a modified version of the Click routing framework being an example) to affect packet routing in accordance with the exemplary embodiment of the invention.

[50] In accordance with an exemplary implementation of the exemplary embodiment of the invention, at least one additional node 410, shown in FIG. 4, may act as a management node responsible for: startup, initial configuration of each router cluster node 402 in the cluster router 400, lookup table synchronization, monitoring, performance reporting, billing, authentication, etc.

[51] In accordance with the exemplary implementation of the exemplary embodiment of the invention, cluster management software, if executing on management nodes 410, communicates with router cluster nodes 402 via dedicated management links 412 ensuring that the cluster intra-connection network does not incur an in-band management overhead. It is envisioned that the management links 412 need not necessitate high bandwidths and therefore the cluster router 400 need not incur a high deployment cost overhead.

[52] In FIG. 4, the management links 412 are shown to form a star topology between the management nodes 410 and the router cluster nodes 402. No such

limitation is implied in respect of the invention, a variety of other topologies may be employed including bus topologies. While employing a bus topology provides native broadcast capabilities, particularly benefiting lookup table synchronization, without necessarily providing a change in the number of management links 412 when compared to the star topology, employing a bus topology exposes the cluster router 400 to a collision overhead in the management links 412. The collision overhead may be mitigated by employing higher bandwidth infrastructure for management links 412 of the bus topology or by employing multiple busses, both adding significant costs to such an implementation. Depending on the size of the cluster router 400 the benefits of the native broadcast capabilities in employing a bus topology may overweigh the cost incurred by the collision overhead. The actual implementation of the management network is therefore left to design choice.

[53] In accordance with an exemplary implementation, the management links 412 may be implemented as serial links. Serial links employ serial ports typically available directly on the motherboard of each PC router cluster node 402 reducing bus connector requirements imposed on the design of each PC motherboard. While the aggregation of all serial links at the management node may require expensive aggregation equipment, such aggregation equipment exists and enjoys standardization.

[54] In accordance with another embodiment of the invention, at least one router cluster node 402 is designated as a management node (410) providing management functionality either on a dedicated basis of in conjunction with providing routing functionality. In case a failure is experienced by the router cluster node designated as the management node, another router cluster node 402 may be designated as the management node (410) on short order without requiring infrastructure modifications to the cluster router 400.

[55] In accordance with another exemplary implementation, management functionality employs in-band signaling and messaging while incurring a small management overhead.

[56] In accordance with the exemplary embodiment of the invention, the same routing functional block definitions are provided to each router cluster node 402 to ensure that each cluster node is capable to perform every and any routing functionality necessary. Details regarding the necessary routing functionality blocks is provided herein below with reference to FIG. 5 and FIG. 6.

[57] Therefore, in accordance with the exemplary embodiment of the invention, the router cluster node configuration specifies cluster-node-centric packet processing flows within each router cluster node 402 such that each router cluster node 402 by itself, and/or the aggregate all router cluster nodes 402 in the cluster router 400 are able to provide packet routing functionality. Details of exemplary cluster-router-node-centric configurations are provided herein below with respect to FIG. 5 and FIG. 6.

[58] For easy understanding of the concepts presented herein and without limiting the invention thereto, router cluster node physical ports are designated as: internal ports, external ports, and loopback ports. Internal ports terminate cluster router internal interconnecting links 404 participating in the intra-connection network implementing the toroidal topology of the cluster router 400. External ports terminate cluster router external links to communication network nodes external to the cluster router 400 (see patch bays in FIG. 4). The loopback ports enable each router cluster node 402 to provide all the necessary and related routing functionality need to process a received packet especially when the packet is to be sent towards the intended destination via an external link associated to the same router cluster node 402 which received the packet.

[59] In order for the cluster router implementation presented herein to replace a single router, not only is it necessary for packets to be processed by the

router cluster nodes 402 of the entire cluster router 400 as if they were processed by a single router, but the entire cluster router 400 must appear to external communications networks and nodes as a single router. Adherence to the requirement is complicated by the fact that different external links are connected to different router cluster nodes 402 in the cluster router 400.

[60] An addressing scheme, perhaps as simple as using Media Access Control (MAC) addressing may be relied on. Internet Protocol addressing may also be used, however reliance on such use, as packets hop from router cluster node 402 to router cluster node 402, may lead to a lot of unnecessary protocol stack processing. In using MAC addressing to refer to each router cluster node 402, each physical port has a globally unique MAC address ascribed thereto during manufacturing thereof, the MAC address of a particular router cluster node 402 may be set to the lowest MAC address value of all of the physical ports associated therewith. It may be necessary that only physical ports used to implement the cluster intra-connection network be considered in an internal router cluster node addressing scheme to ensure that packets do not spill out of the cluster router 400 prematurely while propagating between cluster router nodes 402. In order for the aggregate of router cluster nodes 402 to appear as a single router to external communications networks, the MAC address of the cluster router 400 may be set to the lowest MAC address of all router cluster node ingress and egress external ports (external addressing scheme).

[61] In accordance with an exemplary implementation of the exemplary embodiment of the invention, the MAC address of the cluster router 400 is determined by the router cluster nodes 402 in the cluster router 400 cooperatively. The invention is not limited to this particular method of determining the address of the cluster router 400. However, employing methods of dynamic internal cluster router MAC address determination, takes into account that the router cluster node 402 with the smallest MAC address may be removed and installed at another location in an associated communications network thus preventing packet misdirection.

[62] In accordance with another exemplary implementation of the exemplary embodiment of the invention, the external MAC address of the cluster router 400 may be determined by a management node 410. If the management node is used solely for management of the cluster router 400, then the MAC address of the management node 410 may be used as the MAC address of the entire cluster router 400. If a group of redundant management nodes are used, then the group of management nodes may collectively employ a dynamic external MAC address determination scheme which takes into account that any one of the management nodes 410 may fail or may be relocated in an associated communications network.

[63] In accordance with the exemplary embodiment of the invention, router cluster nodes 402 in the cluster router 400 may employ only a reduced protocol stack in implementing the cluster intra-connection network. If the cluster router 400 is exemplary employed for routing IP packets, the router cluster nodes 402 may only implement Ethernet encapsulation in the cluster intra-connection network.

[64] Having received a routing response, a packet in transit towards the exit router cluster node 402, if unchecked, may circle around the redundant intra-connection network (404) forever introducing an uncontrollable transport bandwidth overhead.

[65] In accordance with the exemplary embodiment of the invention, each packet is tagged to identify the received packet as one having received a routing response and propagating through the cluster router 400 towards the intended exit router cluster node 402. A variety of tagging means may be employed including, but not limited to: using optional headers in packets, adding packet trailers, and/or encapsulating the received packet with additional (Ethernet) headers having cluster router relevance only. Upon arriving at the specified exit router cluster node 402, the tag is removed.

[66] In accordance with the exemplary embodiment of the invention, a TagTTL value is specified in the tag for each tagged packet the TagTTL having cluster router 400 relevance only. An initial MaxTagTTL value would be set to an empirically determined value typically dependent on the size of the cluster router 400. The MaxTagTTL value must be set high enough to enable the packet to traverse the entire cluster router 400, yet the MaxTagTTL value must be set low enough to minimize transport overheads.

[67] In accordance with the exemplary embodiment of the invention, FIG. 5 A, B, and C show a flow diagram representative of a router-cluster-node-centric configuration disseminated to each router cluster node 402.

[68] FIG. 5A is a high level overview of the router-cluster-node-centric configuration 500 (600). In accordance with an exemplary implementation of the exemplary embodiment of the invention, the goal of determining a routing response for each received packet is divided into entry packet processing and routing response processing; and exit packet processing.

[69] Each packet received via an input port 502, 554, 556 is classified to determine which leg of the configuration 500 to subject the packet to. Newly received packets via an external link are directed to an entry packet processing leg, whereby the packet undergoes entry packet processing and routing response processing. Subsequent to receiving a routing response 570, the packet is tagged 540 and forwarded via a cluster router external port 530, internal port 552 or the loopback port 554 as appropriate. The packet may propagate between router cluster nodes 402 before arriving at the exit router cluster node 402 by following the transit leg of the configuration 500.

[70] The exit packet processing leg of the configuration 500 is typically followed upon receiving a packet via an cluster router internal port 556. The packet is then switched to and forwarded via the appropriate external port 530. The tag is removed 582 and the packet TTL is decremented 584 before packet transmission via an external link.

[71] FIG. 5B shows details of the entry packet processing and routing response provisioning leg. A packet is received at the cluster router 400 via an external link and a corresponding external physical port 502. The received packet is typically provided to a packet filtering (firewall) block 504 exemplary subjecting the received packet to packet acceptance rules. If the packet is not accepted, the packet is dropped.

[72] If the packet is accepted by the packet filtering block 504, the packet is forwarded to a decision block 506, which determines whether the packet is specifically destined for the subject router cluster node 402 currently processing the packet. If the packet is destined for the subject router cluster node 402, the packet is forwarded to the Operating System (OS), block 508 – in this case the router cluster node operating system. If the packet is not destined for the router cluster node 402, it is forwarded on to decision block 510.

[73] Decision block 510 determines whether the received packet is destined for the cluster router 400 proper. If the packet is destined for the cluster router 400, the packet is forwarded to a management port output queue block 512 and is eventually transmitted via a management output port 514 to a dedicated management node 410. If a router cluster node 402 is designated as a management node, then the packet is forwarded via an appropriate cluster router internal port 552 towards the designated management node. If the packet is not destined for the cluster router 400, in step 510, the packet is forwarded to decision block 520.

[74] Decision block 520 inspects the packet header to obtain the packet TTL value. If the packet TTL value is too low, the packet is not processed any further with respect to providing a routing response. An ICMP Error "TTL Expired" message is formulated for the packet by block 524. The source and destination network node addressing specifications of the received packet are extracted and reversed, and the packet conveying the ICMP message is provided to the exit packet processing leg. As will be described with reference

to FIG. 5C, the packet is placed on an output port queue 528 (lowest priority) of the external output port 530 corresponding to the input port 502 via which the packet was received. If the decision block 520 does not find a low packet TTL value, the packet is forwarded on.

[75] The packet is typically (but not necessarily) subjected to a packet acceptance rate control block 536. The packet is further processed through various other entry packet processing blocks, for example to check the integrity of the packet header, to remove a number of bytes, etc, which will be omitted from being shown for brevity of the description of the exemplary embodiment presented herein. A person skilled in the art would specify the correct sequence of entry packet processing blocks necessary to support the services provided. Each such block typically performs a combination of: accepting the packet, modifying the packet header, dropping the packet with or without associated processing such as sending a message back, etc.

[76] The packet is classified by classifier block 564 in accordance with the packet's priority for preferential processing and stored in a priority queue 566. Packets are scheduled for routing response processing by scheduler block 568 which preferentially selects high priority packets to be routed thereby enforcing quality of service guarantees. A route lookup is performed by lookup block 570.

[77] Routing response processing results in the packet header being updated with next hop information including a network address of a next communications network node towards which the packet is to be conveyed upon leaving the cluster router 400, as well the tag information is updated with router cluster node addressing information (a MAC address specification) of the corresponding exit router cluster node 402.

[78] Having received a routing response, decision block 571 determines whether the determined next hop network address is connected locally with respect to the subject router cluster node 402. If the network node

corresponding to the next hop network address is connected to a port of to the subject router cluster node 402, then the packet is provided to the exit packet processing leg.

[79] If the network node corresponding to the determined next hop address is not know locally, the packet is tagged (as described above) by tagging block 540. The tag includes a data structure conveyed with the packet. The data structure holds specifiers employed by router cluster nodes 402 to track the packet while in transit within the cluster router 400. A TagTTL specifier is populated with a MaxTagTTL value by block 542. It is worth re-emphasizing that the TagTTL value is independent of the packet TTL value specified in the packet header. The TagTTL value is decremented each time the packet propagates through a router cluster node 402, whereas the packet TTL value is decremented 584 only once as part of packet exit processing by the exit router cluster node 402.

[80] The routed and tagged packet is provided to a switch block 576. The switch block 576, based on the tag information and perhaps header information, queues the routed packet in an internal output port queue 548 or the self queue 550. A packet conveying content will typically be queued in one of the internal output port queues 548 of the router cluster node 548, while packet encapsulated signaling and control messages may be queued in the self queue 550 to implement particular functionality.

[81] Various other routing functions may be provided including, but not limited to, address resolution processing. As packets are exemplary transmitted employing the Internet Protocol (IP), an in-band Address Resolution Protocol (ARP) is employed to access address resolution services provided in a typical IP communication network. The processing of ARP packets is schematically shown in FIG. 5B. Without limiting the invention to the particular implementation shown, a classifier block classifies packets by type: IP packets are provided to classifier block 564, ARP responses are provided to an ARP

responder block, ARP queries and packets processed by the ARP responder are switched by block 576 to respective output-port-associated ARP querier blocks. ARP functionality may also be implemented out-of-band via the management node 410.

[82] Other routing (related) functionality such as, but not limited to: Reverse ARP (RARP), Border Gateway Protocol (BGP), etc. may be implemented in accordance with the exemplary embodiment by specifying an appropriate router-cluster-node-centric configuration.

[83] FIG. 5C shows router-cluster-node-centric configuration details related to processing packets received via an internal port 556, the logical loopback port 554, or from the operating system 558. Such packets may either require special functionality, transit, or exit processing.

[84] A classifier 560 classifies received packets in accordance with information specified in the tag and perhaps also held in the packet header.

[85] If the tag specifies that the received packet requires a special function, such as but not limited to: encryption/decryption, video stream processing (combine, decode, encode, format translation, etc.), authentication, directory services, etc., the packet is provided to the OS, block 508.

[86] Decision block 580 determines whether the subject router cluster node 402 is the exit router cluster node specified in the tag.

[87] If the router cluster node 402 is not the exit router cluster node, the packet is in transit. Decision block 578 determines whether the TagTTL value is zero. If the TagTTL value is zero, the packet is discarded thus preventing packets from circling between router cluster nodes 402 indefinitely. If the TagTTL value is not too low, the TagTTL value is decremented by block 574 and the packet is provided to the switch block 576 for forwarding.

[88] If the subject router cluster node 402 is the exit router cluster node, as part of exit packet processing, the tag is removed by functional block 582, and the packet TTL is decremented by functional block 584. Not all received packets may be tagged, especially packets received via the loopback port 554. The configuration is exemplary of the flexibility provided.

[89] A packet fragmenter block 586 fragments packets in accordance with transport characteristics of the external transport links beyond the router cluster node 402 and therefore beyond the cluster router 400.

[90] A classifier block 588 classifies the packet in accordance with the packet's priority and the packet is stored in an appropriate priority queue 590.

[91] A scheduler block 592, in accordance with a queue service discipline enforcing quality of service guarantees, provides packets from the priority queues 590 to a switch block 594 which takes into account the network address of the next hop communications network node held in the packet header of each packet provided, to determine the appropriate external output port 530 to forward the packet therethrough. The packet is queued for transmission in an external output port queue 528.

[92] Making reference to FIG. 5B, the router cluster node may also receive a packet from the management port 598 which is forwarded to the OS 508.

[93] As mentioned above, the separation between internal and external ports is not necessary. FIG. 6 shows schematically a router-cluster-node-centric configuration 600, corresponding to the router-cluster-node-centric configuration 500 presented in FIG. 5 B and C, with packet processing flow specifications rerouted based on all ports being equivalent. All packets are provided to a decision block 602 determining whether a received packet is tagged or not.

[94] The router cluster nodes 402 need not have the same processing capacity nor be supplied by the same equipment vendor, although use of same vendor

equipment would reduce maintenance overheads typically associated with stocking replacement parts.

[95] However, in providing improved packet processing capabilities, specialized PC platforms may be used for performing specialized packet processing. For example, as mentioned above, a packet payload encryption/decryption packet processing response may be necessary. Encryption/decryption algorithms may make use of specialized CPU processing functionality to speed up packet payload encryption/decryption. A difference exists between employing Complex Instruction Set Computing (CISC) platforms as opposed to Reduced Instruction Set Computing (RISC) platforms. Both CISC and RISC cluster nodes may however run the same operating system, Linux, and the exemplary router framework specially compiled for each specialized PC platform.

[96] Therefore a low-cost, scalable cluster router design is provided. The routing functionality of the cluster router can easily be re-configured via modifying existing or employing additional special purpose routing functionality blocks to support varying customer needs, and different functional requirements. The routing functionality supported by and the configuration of the cluster router may also depend on where the cluster router is deployed in a communications network (edge/core/access).

[97] A low-cost, scalable cluster router is useful as a communications network edge, where cost and scalability are very important. Such a cluster router could also be useful in small enterprise networks for the same reason. The cluster router design further provides a useful research tool due to its high degree of flexibility.

[98] The embodiments presented are exemplary only and persons skilled in the art would appreciate that variations to the above described embodiments may be made without departing from the spirit of the invention. The scope of the invention is solely defined by the appended claims.

WE CLAIM:

1. A cluster-based router comprising:

   a. a plurality of equivalent interconnected router cluster nodes, the routing capacity of the cluster router increasing substantially O(N) with the number N of router cluster nodes in the cluster router;

   b. a plurality of cluster router internal links interconnecting router cluster nodes forming an intra-connection network ensuring a high path diversity in providing resiliency to failures;

   c. each router cluster node having a group of cluster router external links enabling packet exchange with a plurality of external communication network nodes; and

   d. each router cluster node operating in accordance with a provisioned router-cluster-node-centric configuration to effect distributed routing of the conveyed packets,

   the equivalency between the router cluster nodes providing a scalable cluster router.

2. The cluster router claimed in claim 1, wherein the router-cluster-node-centric configuration further comprises routing functional blocks and specifies packet processing flows between the routing functional blocks effecting packet routing employing one of: a single router cluster node, and a sequence of router cluster nodes.

3. The cluster router claimed in claim 1, wherein each router cluster node comprises a personal computer platform providing flexibility and cost savings in the development, deployment, maintenance, and expandability of the cluster router.

4. The cluster router claimed in claim 1, wherein the intra-connection network further comprises an n dimensional toroidal topology, wherein 2*n internal links interconnect each router cluster node with 2*n adjacent neighboring router cluster nodes; the routing capacity of the cluster router being increased substantially linearly by adding an n-1 dimensional slice of router cluster nodes to the cluster router.

5. The cluster router claimed in claim 4, wherein the intra-connection network comprises a three dimensional toroidal topology, wherein six internal links interconnect each router cluster node with six adjacent neighboring router cluster nodes.

6. The cluster router claimed in claim 1, wherein the intra-connection network further comprises one of unidirectional and bi-directional internal interconnecting links.

7. The cluster router claimed in claim 1, further comprising: a router cluster node designated as a management node, should a management node designated router cluster node fail, designating another router cluster node as a management node without making changes to the cluster router infrastructure.

8. The cluster router claimed in claim 1, further comprising:

   a. at least one management node; and

   b. a plurality of management links interconnecting the at least one management node with the plurality of router cluster nodes and enabling one of out-of-band: configuration deployment to each router cluster node, router cluster node initialization, and reporting functionality; employing the plurality of management links reducing an in-band cluster router management overhead.

9. The cluster router claimed in claim 8, wherein the plurality of management links from one of a star and a bus topology.

10. The cluster router claimed in claim 1, further comprising an cluster router internal addressing process dynamically determining router cluster node addressing.

11. The cluster router claimed in claim 1, further comprising a cluster router external addressing process dynamically determining a cluster router address.

12. A router cluster node of a plurality of router cluster nodes interconnected in a cluster router, the router cluster node comprising:

a. a plurality of cluster router internal interconnecting links connected thereto, the internal interconnecting links enabling the exchange of packets with adjacent router cluster nodes in the cluster router;

b. at least one cluster router external link connected thereto, the at least one external link enabling exchange of packets between external communications network nodes and the cluster router; and

c. a router-cluster-node-centric configuration to effect distributed routing of the conveyed packets,

the equivalency between router cluster nodes in the cluster router providing a scalable router.

13. The router cluster node claimed in claim 12, wherein the router-cluster-node-centric configuration further comprises routing functional blocks and specifies packet processing flows between the routing functional blocks effecting packet routing employing one of: a single router cluster node, and a sequence of router cluster nodes.

14. The router cluster node claimed in claim 12, wherein each router cluster node comprises a personal computer platform providing flexibility and cost savings in the development, deployment, maintenance, and expandability of the cluster router.

15. The router cluster node claimed in claim 12, wherein 2*n cluster router internal links interconnect the router cluster node with 2*n adjacent neighboring router cluster nodes in accordance with an n dimensional toroidal topology, the routing capacity of the cluster router being increased substantially linearly by adding an n-1 dimensional slice of router cluster nodes to the cluster router.

16. The router cluster node claimed in claim 12, further comprising: a management link interconnecting the router cluster node to a management node.

17. The router cluster node claimed in claim 12, further providing management functionality.

18. A router-cluster-node-centric configuration enabling the provision of a distributed packet routing response in a cluster router having a plurality of router cluster nodes, the configuration comprising:

    a. a plurality of routing functional blocks; and

    b. at least one cluster-node-centric packet processing flow, via the plurality of routing functional blocks, to effect routing of packets received at the cluster router employing one of a single router cluster node and a group of router cluster nodes.

19. The router-cluster-node-centric configuration claimed in claim 18, further comprising:

    a. an entry-and-routing processing packet processing flow specification;

b. a transit packet processing flow specification; and

c. an exit packet processing packet processing flow specification,

the packet processing flow specifications enabling a received packet to undergo entry and routing processing at an entry router cluster node, optionally transit via at least one intermediary router cluster node, and undergo exit processing at an exit router cluster node.

20. The router-cluster-node-centric configuration claimed in claim 18, wherein the router cluster node configuration further employs a tag conveyed with each packet within the cluster router infrastructure, the tag holding specifiers for tracking packet processing within the cluster router.

21. The router-cluster-node-centric configuration claimed in claim 20, wherein each tag identifies an associated packet as one having received a routing response and propagating through the cluster router towards a specified exit router cluster node.

22. The router-cluster-node-centric configuration claimed in claim 20, wherein each tag comprises a combination of: an optional packet header, a packet trailer, and an additional header encapsulating the associated packet having cluster router relevance only.

23. The router-cluster-node-centric configuration claimed in claim 20, wherein each tag holds a tag time-to-live specification decremented while the associated packet propagates via router cluster nodes in the cluster, the packet being discarded when the time-to-live specification is zero and the packet has not reached a corresponding exit router cluster node thereby reducing transport overheads.

Abstract

A cluster router architecture and methods for performing distributed routing is presented. Implementations include off-the shelf Personal Computer (PC) hardware. The cluster router architecture includes PC-based router cluster nodes toroidally interconnected in an intra-connection network in multiple dimensions. The cluster router may further make use of a management node. Each router cluster node is provided with the same routing functionality and a node centric configuration enabling each router cluster node by itself or multiple router cluster nodes in the cluster router to provide routing responses for packets pending processing. The method divides packet processing into entry packet processing and routing response processing; and exit processing. Entry packet processing and routing response processing is performed by router cluster nodes receiving packets from communication networks in which the cluster router participates. Exit packet processing is performed by router cluster nodes transmitting packets into communication networks in which the cluster router participates. Advantages are derived from: a configurable, and scalable cluster router design providing a high routing capacity using cost effective stock PC hardware; from the toroidal topology of the intra-connection network which provides a high degree of diversity ensuring resilience to equipment failure, and from the use of the star topology of the management links which reduces management overheads in the intra-connection network.

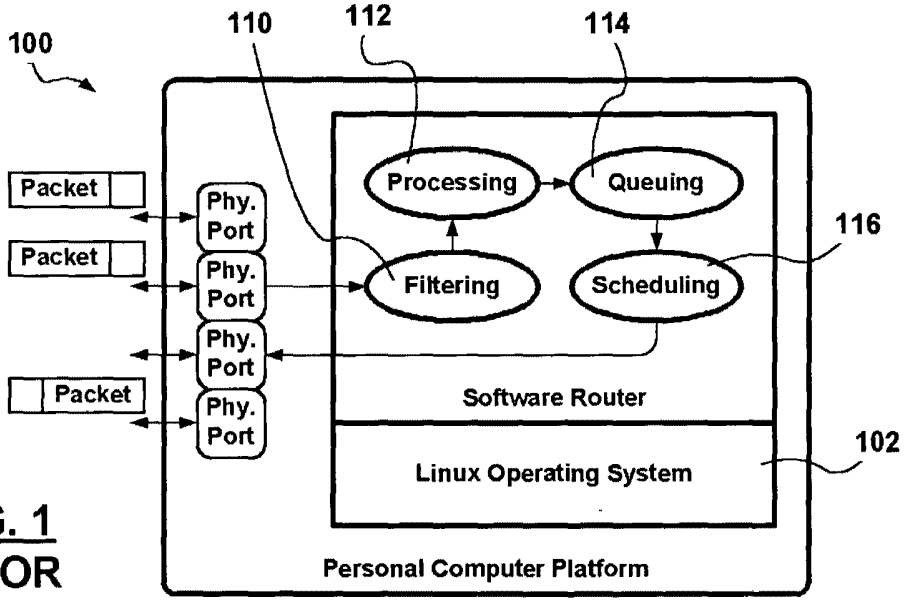


FIG. 1
PRIOR ART

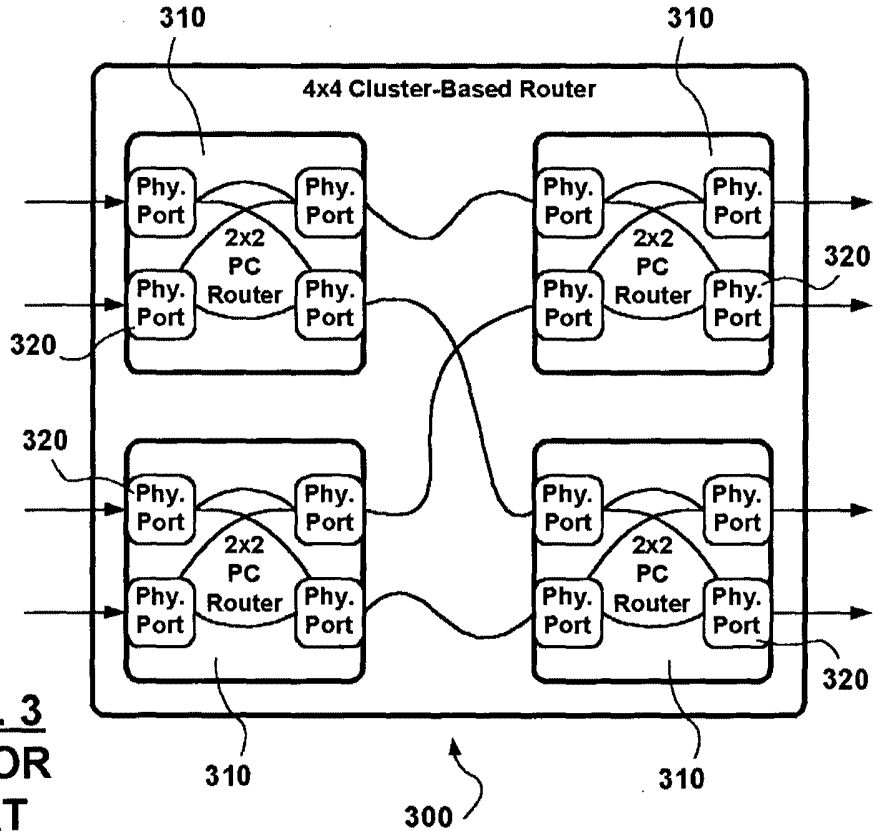


FIG. 3
PRIOR ART

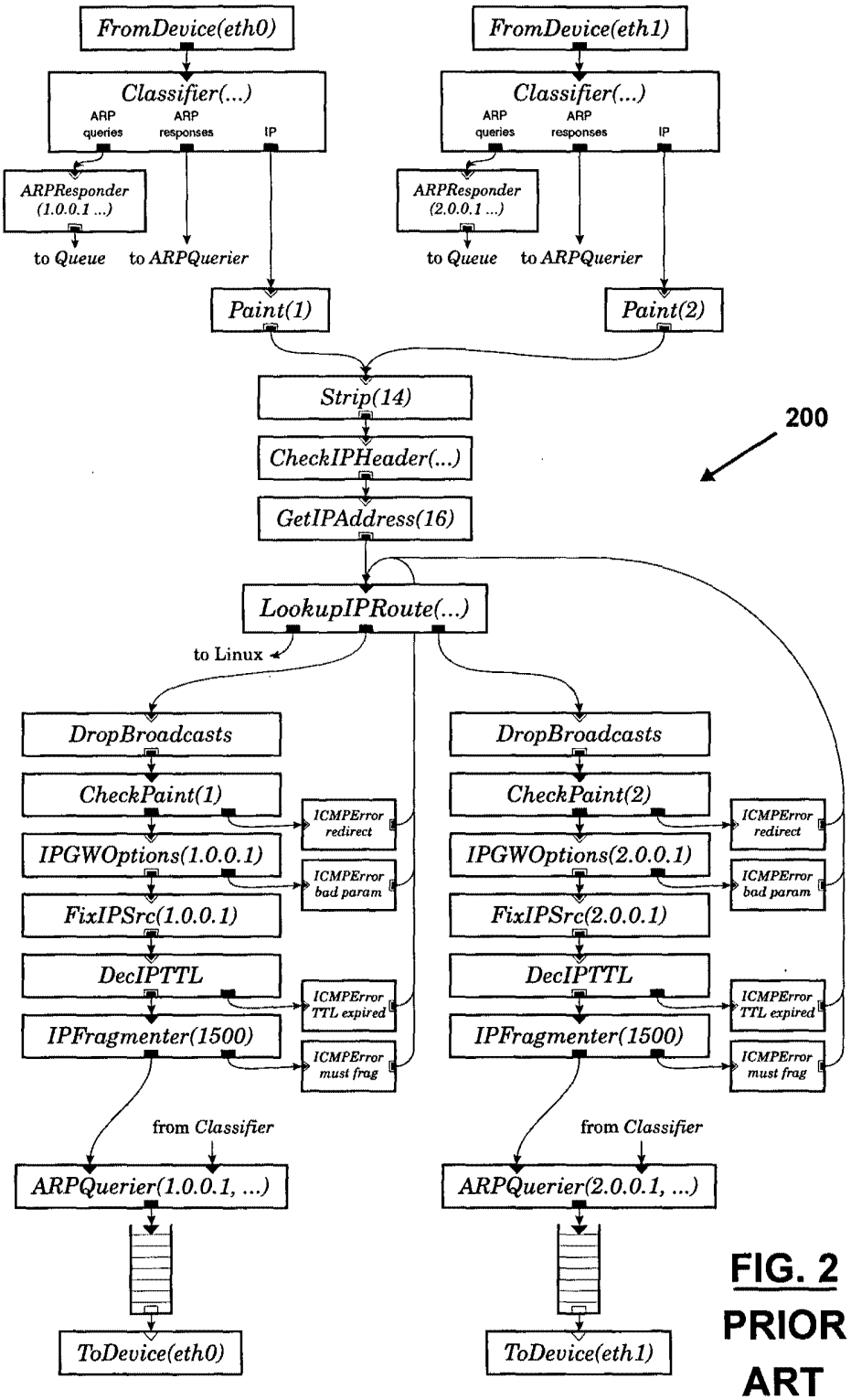


FIG. 2
PRIOR ART

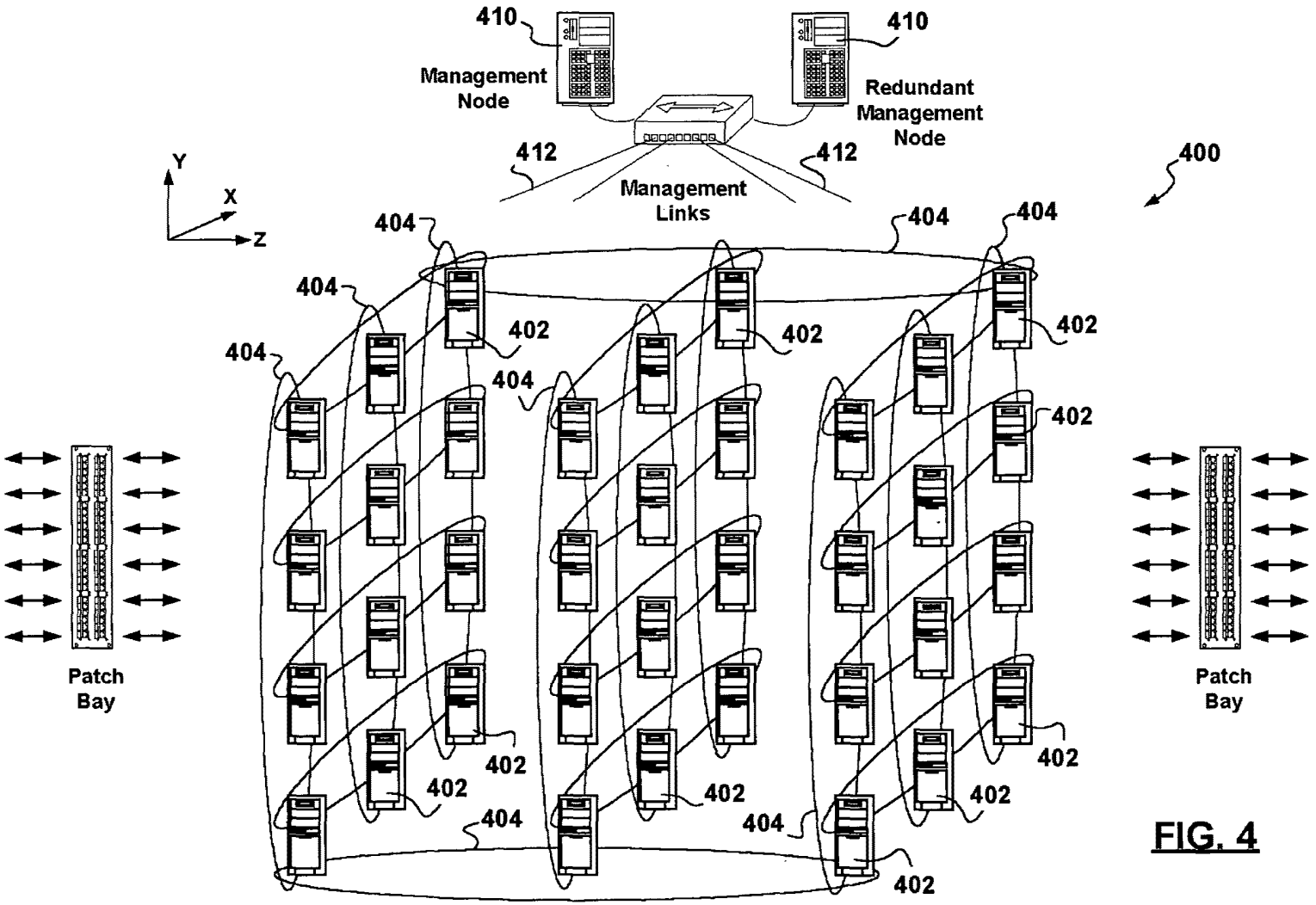

410
Management Node
410
Redundant Management Node
412
412
Management Links
400
Y
X
Z
404
402
Patch Bay
Patch Bay

FIG. 4

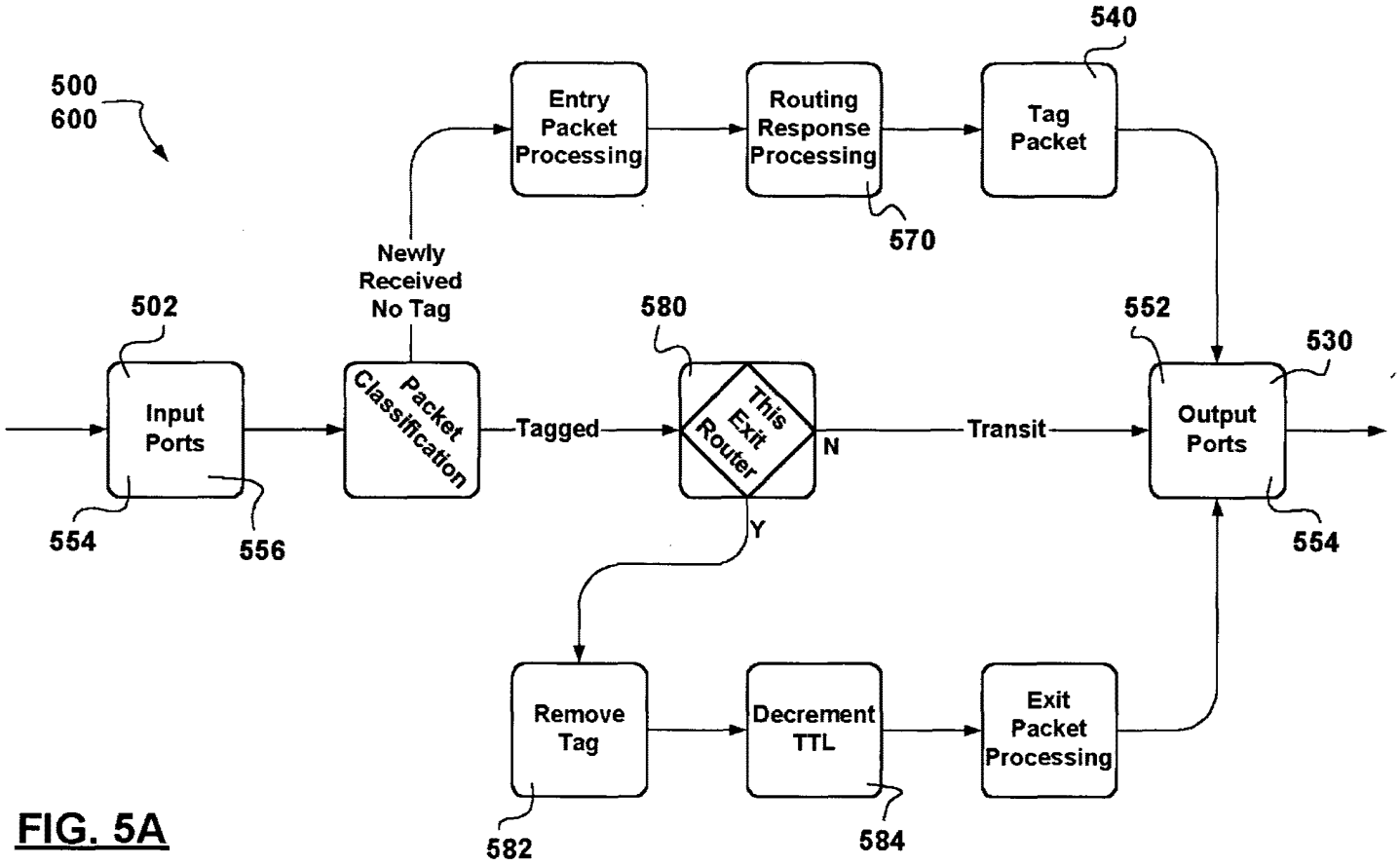

500
600
Entry Packet Processing
Routing Response Processing
570
540
Tag Packet
Newly Received No Tag
502
Input Ports
554
556
Packet Classification
Tagged
580
This Exit Router
N
Y
Transit
552
530
Output Ports
554
Remove Tag
582
Decrement TTL
584
Exit Packet Processing

FIG. 5A

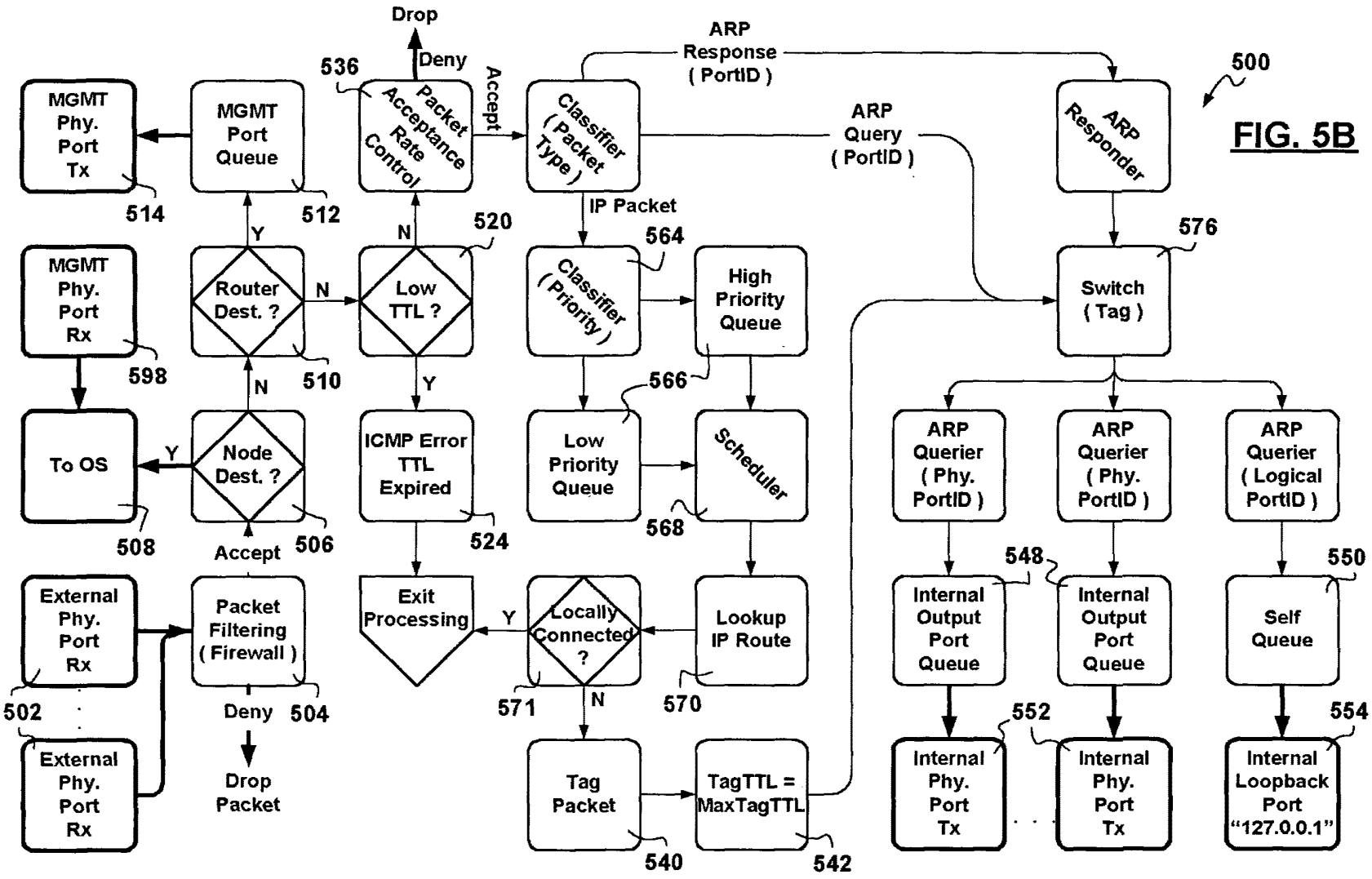
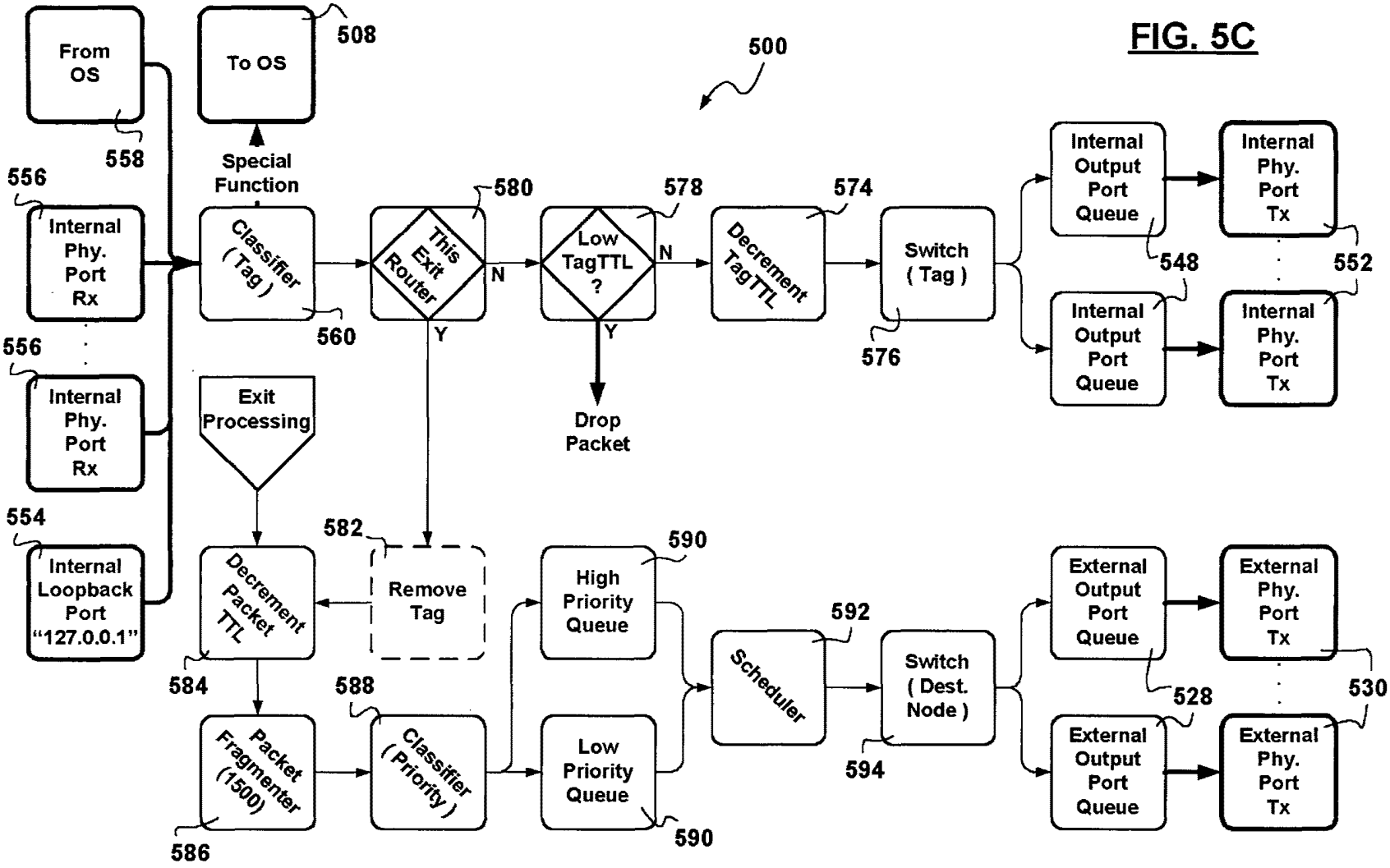

Drop
Deny
536
Packet Acceptance Rate Control
Accept
ARP Response (PortID)
500
ARP Responder
ARP Query (PortID)
Classifier (Packet Type)
MGMT Phy. Port Tx
MGMT Port Queue
514
512
IP Packet
564
Classifier (Priority)
High Priority Queue
576
Switch (Tag)
MGMT Phy. Port Rx
598
Router Dest. ?
510
Low TTL ?
520
566
Low Priority Queue
Scheduler
568
To OS
508
Node Dest. ?
Accept
506
ICMP Error TTL Expired
524
ARP Querier (Phy. PortID)
ARP Querier (Phy. PortID)
ARP Querier (Logical PortID)
548
550
External Phy. Port Rx
502
Packet Filtering (Firewall)
Deny
504
Drop Packet
Exit Processing
Locally Connected ?
571
Lookup IP Route
570
Internal Output Port Queue
Internal Output Port Queue
Self Queue
552
554
External Phy. Port Rx
Tag Packet
540
TagTTL = MaxTagTTL
542
Internal Phy. Port Tx
Internal Phy. Port Tx
Internal Loopback Port "127.0.0.1"

FIG. 5B

FIG. 5C


From OS
558
To OS
508
Special Function
500
556
Internal Phy. Port Rx
556
Internal Phy. Port Rx
554
Internal Loopback Port "127.0.0.1"
Classifier (Tag)
560
This Exit Router
580
N
Y
Low TagTTL ?
578
N
Y
Drop Packet
Decrement TagTTL
574
Switch (Tag)
576
Internal Output Port Queue
548
Internal Phy. Port Tx
552
Internal Output Port Queue
Internal Phy. Port Tx
Exit Processing
582
Remove Tag
Decrement Packet TTL
584
Packet Fragmenter (1500)
586
588
Classifier (Priority)
High Priority Queue
590
Low Priority Queue
590
592
Scheduler
Switch (Dest. Node)
594
External Output Port Queue
528
External Phy. Port Tx
530
External Output Port Queue
External Phy. Port Tx

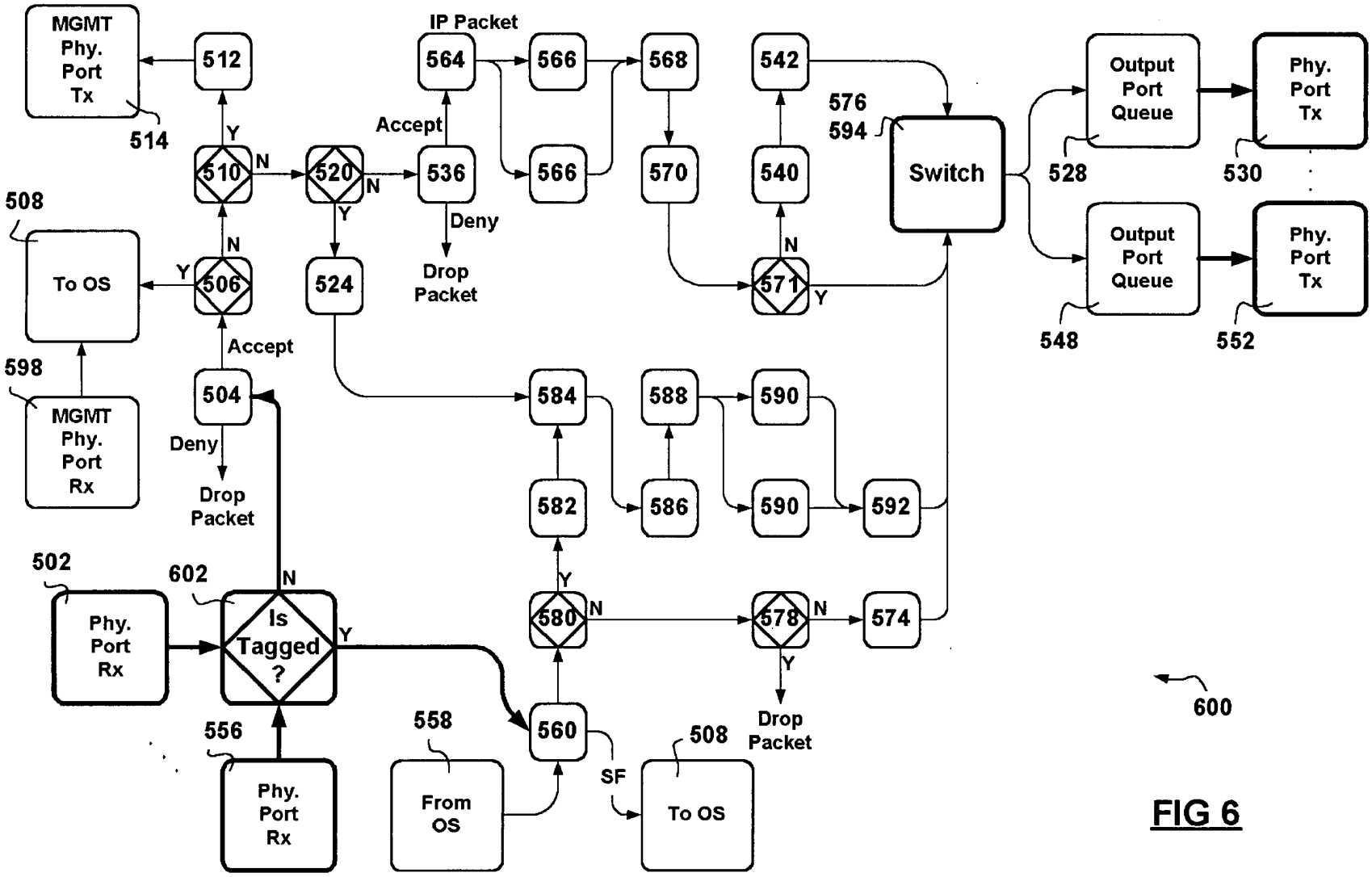

MGMT Phy. Port Tx
514
512
IP Packet
564
566
568
542
576
594
Output Port Queue
Phy. Port Tx
528
530
Accept
510
520
536
566
570
540
Switch
508
To OS
506
524
Deny
Drop Packet
571
548
552
598
MGMT Phy. Port Rx
504
584
588
590
Deny
Drop Packet
582
586
590
592
502
602
Phy. Port Rx
Is Tagged ?
580
578
574
600
556
558
560
508
Drop Packet
Phy. Port Rx
From OS
SF
To OS

FIG 6

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re. Application of: John Lawrence Jordan et al
Serial No.:
Filed:
Title: SOFTWARE CONFIGURABLE CLUSTER-BASED ROUTER USING STOCK PERSONAL COMPUTERS AS CLUSTER NODES

Atty. Docket No.: 137603-US

The Commissioner of Patents and Trademarks
Washington, D.C. 20231
U.S.A.

ASSOCIATE POWER OF ATTORNEY

Dear Sir:

The undersigned, John Granchelli (Reg. No. 39,512), is an agent of record for the captioned U.S. Patent Application under a Power of Attorney filed with the U.S. Patent Office contemporaneously herewith.

Pursuant to 37 CFR Section 1.34(b), the undersigned hereby appoints the following registered practitioner as associate agent of record:

Jim Zegeer, Esq.
Registration No. 18,957

to prosecute said application and to transact all business in the U.S. Patent and Trademark Office connected therewith. The appointment of the above practitioners does not affect, and is not intended to affect, the status of any other practitioner who has been appointed previously as agent of record for this matter.

Please direct any and all correspondence and telephone calls to:

Jim Zegeer, Esq.
Law Office of Jim Zegeer
801 North Pitt Street, #108
Alexandria, VA 22314
Telephone: 703-684-8333
Facsimile: 703-549-8411

Respectfully submitted,

July 21/03
Date

John Granchelli
Reg. No. 39,512

Alcatel Canada Inc.
600 March Road
Ottawa, ON K2K 2E6
CANADA
Telephone: 613-784-6523
Facsimile: 613-784-8923

DECLARATION AND POWER OF ATTORNEY FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63) ☒ Declaration Submitted with Initial Filing. ☐ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16(e)) required).	Attorney Docket No.: 137603-US First Named Invent r: John Lawrence Jordan COMPLETE IF KNOWN Application Number: Filing Date: Group Art Unit: Examiner Name:

As a below named inventor, I hereby declare that:

My residence, mailing address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

SOFTWARE CONFIGURABLE CLUSTER-BASED ROUTER USING STOCK PERSONAL COMPUTERS AS CLUSTER NODES

the specification of which
☒ is attached hereto.
☐ was filed on _____ as United States Application Serial No. _____ or PCT International Application No. and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

Foreign Application(s) and/or Claim of Foreign Priority
I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or any PCT international application having a filing date before that of the application on which priority is claimed.

Country	Application Number	Date Filed	Priority Claimed Under 35 U.S.C. §119
			☐ Yes ☐ No
			☐ Yes ☐ No

Provisional Application
I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below:

Application Serial Number	Filing Date

U.S. Priority Claim
I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

Application Serial Number	Filing Date	Status - Patented/Pending/Abandoned

POWER OF ATTORNEY

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: John Granchelli Registration No. 39,512
Greg Benoit Registration No. 48,067

Address all correspondence to:
John Granchelli
Alcatel Canada Inc.
600 March Road
Ottawa, ON K2K 2E6
CANADA

Direct telephone calls to: John Granchelli Phone (613) 784-6523 Fax (613) 784-8923

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor: **John Lawrence Jordan**

Sole or first inventor's signature: _____ Date: July 21 2003
Residence: City **Ottawa** State **Ontario, Canada** Citizenship: **Canadian**
Mailing Address: **126 Blackdome Crescent, Ottawa, Ontario, K2T 1A7, CANADA**

Full name of second inventor, if any: **Peter Rabinovitch**

Second inventor's signature: _____ Date: 15-JUL-03
Residence: City **Kanata** State **Ontario, Canada** Citizenship: **Canadian**
Mailing Address: **1386 Halton Terrace, Kanata, Ontario, K2K 2R1, CANADA**

Full name of third inventor, if any:

Third inventor's signature: _____ Date: _____
Residence: City _____ State _____ Citizenship: _____
Mailing Address: _____

Full name of fourth inventor, if any:

Fourth inventor's signature: _____ Date: _____
Residence: City _____ State _____ Citizenship: _____
Mailing Address: _____

Full name of fifth inventor, if any:

Fifth inventor's signature: _____ Date: _____
Residence: City _____ State _____ Citizenship: _____
Mailing Address: _____

Full name of sixth inventor, if any:

Sixth inventor's signature: _____ Date: _____
Residence: City _____ State _____ Citizenship: _____
Mailing Address: _____

PATENT APPLICATION FEE DETERMINATION RECORD
Effective January 1, 2003

Application or Docket Number: 16625667

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS	23	
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	23 minus 20=	* 3
INDEPENDENT CLAIMS	3 minus 3 =	* 0
MULTIPLE DEPENDENT CLAIM PRESENT		☐

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☐		OR	OTHER THAN SMALL ENTITY	
RATE	FEE		RATE	FEE
BASIC FEE	375.00	OR	BASIC FEE	750.00
X$ 9=		OR	X$18= 54.	
X42=		OR	X84=	
+140=		OR	+280=	
TOTAL		OR	TOTAL	804

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X42=		OR	X84=	
+140=		OR	+280=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X42=		OR	X84=	
+140=		OR	+280=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X42=		OR	X84=	
+140=		OR	+280=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

FORM PTO-875 (Rev. 12/02) *U.S. Government Printing Office: 2003 — 498-278/69151 Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

PATENT APPLICATION SERIAL NO. _____

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

07/25/2003 FFANAEIA 00000025 260090 10625667

02 FC:1001		750.00 OP
03 FC:1202	40.00 DA	14.00 OP

PTO-1556
(5/87)

*U.S. Government Printing Office: 2002 — 489-267/69033